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Short Report

Allelopathy of Japanese angelica-tree

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Introduction

Japanese angelica-trees (*Aralia elata* Seeman) are deciduous shrubs that belong to *Araliaceae*. They grow wild and their buds are eaten as vegetables. While varieties without thorns are cultured, Japanese angelica-trees are obstacles in afforestation.

These trees multiply primarily by their widespreading roots. Weeds and poor growth of surrounding crops are factors often observed in fields where they exist, indicating probable allelopathy of Japanese angelica-trees. In this study, effects of these trees on the growth of some kinds of crops were in-

vestigated.

Materials and Methods

The study was done on sand at the farm of Fukui Prefectural College in 1989. Cabbage, lettuce, Japanese hornwort, welsh onion, garland chrysanthemum, tomato, eggplant, sweetcorn, buckwheat, soybean, kidney bean, edible burdock, carrot, and taro were used. They were cultured in a field subsequent to Japanese angelica-tree culture. The trees over a two year period were removed from the field (hereinafter referred to as Experiment) together with their roots of more than ≈ 5 mm in diameter on 26 Apr. 1989. There had been no other crop in this field and weeds had been removed by hand during the two year period. The field had been fertilized only in 1987. Five 5×0.9 m and 0.1 m high raised beds were prepared and spaced center to center 1.2 m apart on the same day the trees were removed. A 16N-13P-14K granular

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Fig. 1 Growth of crops subsequent to Japanese angelica-tree cultivation

○ : Control, ● : Japanese angelica-tree field

fertilizer ($150 \text{ g} \cdot \text{m}^{-2}$) and $20\text{MgO}-70\text{CaO}$ magnesium lime ($50 \text{ g} \cdot \text{m}^{-2}$) were preplant-broadcast and incorporated before bedding. Three beds were divided into 4 plots of $1.25 \times 0.9 \text{ m}$ each. Crops except cabbage were seeded in two furrows with 0.5 m spacing in each plot on 16 May. After germination, they were thinned as necessary. Cabbage seeds were sown in a greenhouse on 9 March and seedlings were grown by the usual method. A entire bed was used for the planting of taro tubers and another bed was used for cabbage seedlings. Both crops were planted in staggered row; between-row plant spacing was 0.5 m and within-row plant spacing was 0.5 m . Planting dates of planting of cabbage and taro were 26 Apr. and 16 May, respectively. A $0.05\text{N}-0.025\text{P}-0.04\text{K}$ liquid fertilizer ($2 \text{ l} \cdot \text{m}^{-2}$) was applied on 1 Aug.. Height of ten arbitrary plants per crop were measured. Crops were harvested at suitable times, and top fresh weight, undergroundpart fresh weight, fruit weight, and head weight were measured.

The same methods were implemented in another field in the farm of Fukui Prefectural College where no Japanese angelica-tree had ever grown (hereinafter referred to as Control). After a culture of eggplant in 1987, no

crop had been cultured in the field and no fertilizer had been applied until the experiment reported here. The field had occasionally been tilled to abolish weeds.

Results and Discussion

Lettuce, Japanese hornwort, and edible burdock seeds did not germinate in the Experiment, while all three grew normally in Control (data not shown).

Plant height of welsh onion, garland chrysanthemum, tomato, eggplant, carrot, and taro were reduced in Experiment from the early growth stage and that of soybean and kidney bean was reduced from the middle growth stage on. Plant height of sweetcorn and buckwheat were only slightly reduced in Experiment (Fig. 1).

Growth retardation of the Experiment crops was observed at the time of harvest (Table 1), and indicated the allelopathy of the Japanese angelica-tree. Though duration of the effect of the allelopathic agent(s) is uncertain, growth retardation continued for a fairly long period.

Generally, the concentration of fertilizer, especially nitrogen, in soil affects plant growth. However there was believed to be little difference in the concentration of these

Table 1. Growth of crops subsequent to Japanese angelica-tree cultivation
(Figures indicate percentage of Experiment against Control)

Crop	Plant height	Top fresh weight	Underground-part fresh weight	Fruit weight	Head weight
Welsh onion	61.5	32.6	—	—	—
Garland chrysanthemum	51.8	40.2	—	—	—
Tomato	64.4	38.5	—	—	—
Eggplant	73.5	72.5	—	—	—
Sweetcorn	90.3	97.1	—	—	—
Buckwheat	92.6	49.2	—	—	—
Soybean	81.0	93.5	—	99.0	—
Kidney bean	63.3	45.9	—	44.7	—
Carrot	89.0	42.5	32.8	—	—
Taro	69.6	32.5	34.5	—	—
Cabbage	—	61.6	—	—	54.7

substances in the soil between Control and Experiment at the beginning of this experiment as the soil was sand and no fertilizer had been applied to either plot for more than a year. The amount of applied basal fertilizers was also minimal in order that growth would not be retarded by salt injury. It seems possible that the decreased nitrogen in the soil caused by decomposition of the remaining roots of the Japanese angelica-tree influenced the growth of crops in Experiment. But it is difficult to think that this phenomenon was the only reason for the inferior growth as Japanese angelica-trees do not have many thin roots and their decomposition is slow in dryable sand. Further study is needed on other possible influential factors by applying more basal fertilizers or by increasing the number of side dressings.

Many compounds are reported to be allelochemicals (2). Arbors generally contain phenolic compounds in their roots. These may also be the cause of allelopathy in this case. Saponin contained in Japanese angelica-trees is one of the likely causes as it has much to do with sugar metabolism (1). More studies to identify the allelopathic agent (s) of Japanese angelica-tree are necessary.

Inhibition of nitrification, of hormone-induced growth, of mineral uptake, interruption of mitosis etc. are reportedly action

mechanisms of other plants' allelopathic agents (3). The mechanisms of the agent (s) of the Japanese angelica-tree are not yet clear; no effect of growth promotion was observed. On the other hand, soybeans grown in the field from which the trees had been removed achieved almost equal fruit yield to those in the field where no Japanese angelica-tree had ever grown, in spite of retardation of the former's plant height. This becomes rather an advantage in respect to lodging resistance.

Though care must be taken in culturing crops following Japanese angelica-tree culture, allelopathy of this tree is beneficial for weed control by revealing sensitive weeds and the duration of its allelopathic effect.

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