Root Juice of Japanese Angelica-tree Retards Seedling Growth of some Vegetables

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Summary

Effects of root juice of Japanese angelica-tree on the germination of vegetable seeds and seedling growth of vegetables were tested. Germination of eggplant, green pepper, kidney bean, pea, sweetcorn, and turnip green seeds were retarded by the 10-fold diluted root juice (by weight). One hundred-fold diluted root juice retarded seedling growth of *komatsuna*, garland chrysanthemum, spinach, Japanese hornwort, beafsteak plant, welsh onion, asparagus, tomato, eggplant, green pepper, cucumber, pumpkin, soy bean, kidney bean, sweetcorn, okra, radish, turnip green, carrot, and edible burdock. The sensitvity to the root juice was different among the vegetables.

Introduction

Japanese angelica-trees (*Aralia elata* Seeman) are deciduous shrubs growing nationwide. Some varieties without thorns have been cultured. Poor growth of crops and weeds are often observed around Japanese angelica-trees. Miyajima (1991) reported the poor growth of some kinds of vegetable in the field where Japanese angelica-tree was cultured and indicated allelopathy of root of Japanese angelica-tree[1]. In this study, effects of root juice of Japanese angelica-tree on the germination of seeds and seedling growth of some vegetables were investigated.

Materials and Methods

Seeds of lettuce, *komatsuna* (*Brassica campestris* L. rapiferafroug), garland chrysanthemum, spinach, Japanese hornwort, beafsteak plant, welsh onion, asparagus, tomato, eggplant, green pepper, cucumber, pumpkin, soy bean, kidney bean, pea, sweetcorn, okra, radish, turnip green, carrot, and edible burdock were used. Japanese angelica-trees cultured during about 2 years was digged up in spring, the roots more than $\approx$ 5 mm in diameter were mashed with 4-fold distilled water at fresh weight basis by a electric

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mixer for 3 minutes. Then the juice was squeezed and used for the following tests.

Germination test

One hundred seeds of each vegetable, except beans, sweetcorn, and pumpkin, were placed on a sheet of filter paper laid in a 9 cm petri dish with 5 ml of distilled water or diluted juice (10-fold of original root by weight). The number of beans, sweetcorn, and pumpkin seeds placed in a petri dish were 50, 50, and 25, respectively. Twenty ml of distilled water or diluted juice were poured into a petri dish with beans, sweetcorn, pumpkin, and okra seeds. The petri dishes were kept at 20°C, illuminated by white fluorescent lamps (4000 lx at petri dish level) for 12 hours. Seed number germinated were counted during 2 weeks. Germination tests were replicated four times per vegetable.

Effect of root juice on the growth of vegetable seedlings

Experiments were done in a heated greenhouse kept at more than 20°C in Nov. and Dec. 1990. Twenty germinating seeds of each vegetable were sown in vermiculite in a polypropylene box (345 × 270 × 70 mm) for raising seedlings. Two boxes were prepared for a vegetable. When cotyledon unfolded, 500 ml of nutrient solution formulated as Table 1 was applied to each polypropylene box. Root juice of Japanese angelica-tree was applied when first true leaf unfolded except welsh onion, which was applied when second true leaf unfolded. Another application was done after a week. The diluted root juice (100-fold of original root by weight) with the nutrient solution (formulated as Table. 1) was applied to a polypropylene box of each vegetable (500 ml per box ; referred to as Experiment in the following). Five hundred ml of nutrient solution formulated as Table 1 was applied to a polypropylene box of each vegetable (refered to as Control in the following). Watering was done suitably. Seedlings were harvested a weak after the second application. Leaf number, plant height, length of the longest leaf, and top fresh weight were measured.

Table 1. Formulation of nutrient solution.

Chemicals	Content (mg・l^{-1})
$MgSO_4 \cdot 7H_2O$	500
$Ca(NO_3)_2 \cdot 4H_2O$	950
KNO_3	810
$NH_4H_2PO_4$	155
Fe-EDTA	24
Cu-EDTA	0.38
Mn-EDTA	4.4
Zn-EDTA	0.15
$Na_2B_4O_7$	4.5
$Na_2M_0O_4$	0.02

Results and Discussion

Effects of root juice of Japanese angelica-tree on the germination of seeds of vegetables are shown in Table 2. Germination of seeds of eggplant, green pepper, kidney bean, pea, sweetcorn, and turnip green were retarded by root juice of Japanese angelica-tree. Retardations of seed germination of crops or weeds by other crops are reported previously[2]. Allelopathy is considered to be one of factors of lower germination percentage in the field than in the petri dish test.

Effects of root juice on the growth of seedlings of vegetables are shown in Table. 3. Seedlings used in this experiment were retarded their growth except lettuce and pea. Leaf number of lettuce increased by the application of root juice of Japanese angelica-

Table 2. Effects of root juice of Japanese angelica-tree on the germination of some vegetable seeds.

Vegetable	Germination percentage (%)		
	Distilled water	Root juice	
Lettuce	99.5	99.5	NS
Komatsuna	94.0	89.3	NS
Garland chrysanthemum	48.3	45.0	NS
Spinach	100.0	96.3	NS
Japanese hornwort	86.3	83.8	NS
Beafsteak plant	62.3	70.8	NS
Welsh onion	96.3	88.0	NS
Asparagus	91.0	85.5	NS
Tomato	82.5	79.8	NS
Eggplant	91.3	57.0	**
Green peppar	81.3	30.5	**
Cucumber	99.5	99.8	NS
Pumpkin	19.7	20.0	NS
Soy bean	100.0	97.3	NS
Kidney bean	93.5	78.5	*
Pea	96.5	83.8	*
Sweetcorn	73.0	58.0	*
Okra	80.5	84.5	NS
Radish	89.5	85.8	NS
Turnip green	83.5	63.0	*
Carrot	87.3	85.8	NS
Edible burdock	95.5	95.8	NS

NS, **, * Non significant, significant at the 1%, 5% level, respectively, by *t* test.

Table 3. Effect of root juice of Japanese angelica-tree on the growth of seedlings of some kinds of vegetable (% of control).

Vegetable	Leaf number	Plant height	Length of the longest leaf	Top fresh weight	Top dry weight
Lettuce	117**	—	97^{NS}	98^{NS}	97^{NS}
Komatsuna	88**	—	75**	59**	74**
Garland chrysanthemum	87*	—	82*	61**	73**
Spinach	96^{NS}	—	83**	83*	90^{NS}
Japanese hornwort	78**	—	98^{NS}	72**	83*
Beafsteak plant	73**	72**	—	62**	65**
Welsh onion	83**	—	84**	74**	81*
Asparagus	100^{NS}	—	90*	63**	72**
Tomato	92**	49**	—	48**	53**
Eggplant	100^{NS}	85*	—	100^{NS}	110^{NS}
Green pepper	85**	75**	—	50**	77**
Cucumber	103^{NS}	87*	—	95^{NS}	105^{NS}
Pumpkin	109^{NS}	84**	—	80^{NS}	80^{NS}
Soy bean	92^{NS}	81**	—	99^{NS}	101^{NS}
Kidney bean	99^{NS}	68**	—	83^{NS}	83^{NS}
Pea	95^{NS}	84^{NS}	—	80^{NS}	87^{NS}
Sweetcorn	98^{NS}	70**	—	79^{NS}	90^{NS}
Okra	96^{NS}	77**	—	54**	73**
Radish	94^{NS}	—	72**	61**	70*
Turnip green	99^{NS}	—	77**	62**	67**
Carrot	106^{NS}	—	87**	85^{NS}	89^{NS}
Edible burdock	79**	—	69**	51**	61**

NS, **, *, Non significant, significant at the 1%, 5% level, respectively, by *t* test with Welch's correction.

tree. However, there was no significant promotive effects in growth except lettuce. The growth of welsh onion, garland chrysathemum, tomato, eggplant, sweetcorn, soybean, kidney bean, and carrot were retarded in the field where Japanese angelica-tree had been cultured[1]. Also there is difference of sensitivity to the root juice. The top fresh weight of tomato and green pepper decreased markedly by the root juice. In eggplant, belonging to the same family, only plant height decreased by the root juice.

The root juice retarded only plant height of cucumber, pumpkin, soybean, kidney bean, sweetcorn, and carrot. Miyajima reported that plant height of soybean planted in the field where Japanese angelica-tree had been cultured was inferior to that in the field where no Japanese angelica-tree had been cultured, but fruit yield was not decreased[1]. Therefore, root juice of Japanese angelica-tree may be used as a growth retardant for some vegetables.

Literature cited

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タラノキ根部搾汁液による数種野菜の幼苗の生育抑制

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摘　　要

タラノキの根部搾汁液が野菜種子の発芽と幼苗の生育に及ぼす影響を調べた。ナス，ピーマン，インゲン，エンドウ，スイートコーン，カブの種子は10倍に薄めたタラノキ根部搾汁により，発芽が抑制された。100倍に薄めたタラノキ根部搾汁はコマツナ，シュンギク，ホウレンソウ，ミツバ，シソ，ネギ，アスパラガス，トマト，ナス，ピーマン，キュウリ，カボチャ，ダイズ，インゲン，スイートコーン，オクラ，ダイコン，カブ，ニンジン，ゴボウの幼苗の生育を抑制した。しかしタラノキ根部搾汁液への感受性の大小は作物により異なった。

Key words: Japanese angelica-tree, vegetable seedlings, growth ratardant, タラノキ，野菜の幼苗，生育抑制