RGANIC ACID INHIBITING GERMINATION AND GROWTH OF TOBACCO SEED

ABSTRACT

The effect of four organic acids (benzoic, *p*-hydroxybenzoic, salicylic and malic acids) on germination and the whole process tobacco seeding were investigated. Results showed that phydroxybenzoic and malic acids did not affect the germination rate, while the germination rate decreased with the concentration increase of benzoic and salicylic acids. Tobacco seedlings were grown in Hoagland nutrient solution with benzoic, p-hydroxybenzoic, salicylic and malic acids at concentration of 0, 100, 200, 400, 600 and 800 µM respectively. The dry and fresh weights of the whole plant showed increase firstly and decreased afterward with the concentration increase of benzoic, p-hydroxybenzoic and salicylic acids. The malic acids did not affect the dry and fresh weights of the plant. The microbial number of soil actinomyces was decreased with the concentration increase of benzoic and *p*-hydroxybenzoic acids, and increased firstly and decreased afterward with the concentration increase of salicylic and malic acids.

INTRODUCTION

Tobacco (Nicotiana tabacum L.) is a leafy, annual, solanaceous plant grown commercially for its leaves. It is a quite important economic crop in southwest China. Tobacco has allelopathy property by releasing allelochemicals to their surroundings, Tobacco roots exude a variety of low-molecular weight organic compounds (Cecile Bertin, 2003) including sugars and simple polysaccharides (such as arabinose, fructose, glucose, maltose, mannose, oligosaccharides), amino acids (such as arginine, asparagine, aspartic, cysteine, cystine, glutamine), organic acids (such as acetic, ascorbic, benzoic, ferulic, malic acids), and phenolic compounds (p-hydroxybenzoic, caffeic, p-coumeric, ferulic, gallic, gentisic, protocatechuic, salicylic).

The objective of this study was to investigate the effects of four organic acids on the germination of tobacco seeds, growth of seedlings and and to investigate how these effects are expressed for the individual organic acid. Benzoic (BA), p-hydroxybenzoic, (p-OHBA), salicylic (SA) and malic acids (MA) were chosen according to the report of Allelopathy of Root Exudates (Cecile Bertin, 2003).

Mao-sheng Wang , Han-cheng Wang Guizhou Tobacco Reasearch Institute, Guiyang 550081, P.R. China

Figure 1. Time-course of tobacco seed germination on the filter paper in the sealed dishes supplemented with different concentrations of 0, 100, 200, 400, 600 and 800 µM of BA (A), p-OHBA (B), SA (C) and MA (D), respectively. Every dish was supplied with 5 ml fresh solution before the Petri dishes were sealed. Capped bars stand for standard errors.



Table 1. Dry weight (g) of 60-day-old tobacco plants, which exposed to BA, p-OHBA, SA and MA. The nutrient solution was changed and supplemented with the individual organic acids compound every fourth day, n=3, bars labeled with the same letter do not differ significantly in total weight according to Tukey's test (P < 0.05).

Organic	Donta	Concentration (µM)							
acids	rarts	0 μΜ	200 μM	400 μM	600 µM	800 μM	1000 μM		
BA	aboveground	0.52±0.19ab	0.45±0.15ab	0.56±0.12a	0.46±0.14ab	0.39±0.09ab	0.28±0.12b		
	underground	0.11±0.01a	0.1±0.01a	0.11±0.02a	0.13±0.02a	0.11±0.04a	0.11±0.02a		
p-OHBA	aboveground	0.53±0.18ab	0.58±0.24a	0.53±0.15ab	0.54±0.19ab	0.31±0.03ab	0.26±0.06b		
	underground	0.11±0.02ab	0.16±0.04a	0.12±0.04ab	0.13±0.01ab	0.1±0.02b	0.1±0.04b		
SA	aboveground	0.5±0.14ab	0.7±0.18a	0.5±0.09ab	0.4±0.2b	0.2±0.03c	0.2±0.05c		
	underground	0.1±0.03a	0.1±0.03a	0.1±0.02a	0.1±0.02a	0.1±0.04ab	0.1±0.02a		
MA	aboveground	0.56±0.1a	0.6±0.18a	0.47±0.2a	0.43±0.32a	0.47±0.05a	0.66±0.07a		
	underground	0.14±0.03a	0.16±0.01a	0.17±0.02a	0.14±0.03a	0.14±0.03a	0.14±0.03a		



Table 2. Root system characteristics of 60-day-old tobacco plants, which exposed to BA, p-OHBA, SA and MA. The nutrient solution was changed and supplemented with the individual organic acids compound every fourth day, n=3, bars labeled with the same letter do not differ significantly in total weight according to Tukey's test (P < 0.05).

		(cm²)	Tips number	Organic acids	(cm)	(cm ²)	Tips number
0	441.7±61.02ab	88.1±16.09ab	597.7±14.22a	BA	572.1±115.47a	111.2±17.76a	731±239.33a
200 4	-35.4±126.75abc	93.6±13.9a	483.3±146.48ab		486±37.98ab	93.8±11.19ab	513.3±114.42ab
400	558.2±69.32a	98.4±13.86a	595±149.71a		432.5±39.33bc	87.8±4.42ab	458±123.53b
600 ·	459.9±62.72ab	89.2±15.09ab	441±45.21ab		348.6±75.2c	79.6±19.67b	381.3±117.65b
800	395.3±53.34bc	77.4±13.43ab	495±37.04ab		371.7±74.97bc	73.4±16.17b	483±82.5b
1000	306.5±23.27c	68.3±6.31b	343.7±28.57b		362.5±21.46c	74.4±3.36b	392.3±21.96b
0	459.6±41.39a	91±12.62a	703.7±94.51a	p-OHBA	451.9±73.73b	78.1±9.02b	633.3±75.98a
200	525.9±82.33a	95.5±11.18a	458.3±55.32b		561.9±6.51ab	99.6±8.46a	670±114.45a
400	447.3±31.1a	88.5±3.4a	593.3±26.56ab		482.8±29.21b	97.3±4.11a	769±39.36a
<i>р</i> -ОНВА 600	409.9±99.72a	81.5±17.85a	433.7±119.13b		559.9±71.34ab	112.1±3.82a	680±64.58a
800	424.7±77.3a	82.2±16.52a	507±62.86b		542.6±35.95ab	104.9±8.45a	766.3±131.02a
1000	459.6±41.39a	91±12.62a	515.7±145.58b		605.1±105.56a	110.8±14.83a	702.7±72.54a

CONCLUSION

p-OHBA (B) and MA (D) nearly did not affect the germination, whereas BA (A) and SA (C) significantly inhibited the germination of the tobacco seeds, germination rates reduces obviously with increasing concentration of BA (A) and SA (C). Germination rates of tobacco seeds reached nearly 100% when treated with BA at less than 800 µM and with SA at 400 µM. Germination rate was less than 10% at each treatment of SA.

2 Dry weights (Table 2) increased first, and then decreased with increasing concentration of all the tested organic acids, except for MA. However, effects on dry weight of aboveground parts were more notable than that of underground parts.

3 p-OHBA did not affect the total length of roots, while other three organic acids affected significantly. With the increase of the concentration of organic acid, the total length of roots showed the trend of first increased and then decreased in different treatments of BA, gradually decreased in different treatments of SA, and gradually increased for MA. Total root surface and average diameter of above treatments presented the same trend, except for average root diameter treated with MA. BA and p-OHBA did not affect total volume of root. With the increase of the concentration of SA, the total volume of root showed the trend of gradual decrease, and the trend first increased and then decreased for MA. BA, p-OHBA and SA significantly affected the tip number and showed the trend of decreased gradually, except for MA. MA did not affect fresh weight, BA, p-OHBA and SA significantly affected the tip number with a gradual decrease trend.



1 Different organic acids at different concentration had different effects on germination of tobacco seeds.