Promoting Effect of Nano-selenium on Tobacco Growth and Reactive Oxygen Species Metabolism

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1. Introduction

Selenium (Se) is an essential trace mineral for mammals, and has important functions such as antioxidation, anticarcinogenic effects, and immunity stimulation. Even though Selinite and Nano-Se have a similar transformation route, it has been demonstrated that nano-Se has higher biological activity and lower toxicity than selenite. The objective of this research was to study the effect of increased nano-Se concentration in two tobacco cultivars widely used in tobacco production in China.

2. Materials and methods

Experimental materials and design

A pot experiment was carried out in greenhouse , Two popular tobacco cultivars in China, Ey' an 1, a type of burley tobacco, and K326, a type of flue-cured tobacco, were used in this study.

Three concentration levels of nano-Se were set to 0 mg L^{-1} (Control), 2.5 mg L^{-1} (T1), and 5.0 mg L^{-1} (T2), and 10 repetitions for each treatment.

Parameters measurement

Leaf samples of tobacco were ground and homogenized in sodium phosphate buffer (50 mM, pH 7.0) in an ice bath using a mortar and pestle. Then the sample was centrifugated at 10000×g, 4°C for 10 minutes. The supernatant was collected for detection of enzyme activities of superoxide dimutase (SOD), peroxidase (POD), and catalase (CAT) using the following method. Leaf SOD activity was measured by the nitro-blue tetrazolium reduction method. SOD activity was assayed based on the reduction of NBT (nitroblue tetrazolium), and one unit of SOD activity (U) was defined as the amount of enzyme that caused 50% inhibition of NBT reduction. Leaf POD activity was determined by measuring the absorbance changes at 470 nm at 25°C using guaiacol method CAT activity of root was measured by ultraviolet absorption CAT activity was calculated as the amount of enzyme that caused a reduction in absorbance at 240 nm.

Statistical analysis

All the statistical analyses were conducted with SPSS 21.0 (SPSS software Inc., USA), using a two-way ANOVA. Cultivar and nano-Se treatment were considered as fixed effect meanwhile replicated was considered as random. When the main effect of cultivar, nano-Se treatment, or the interaction was considered significant ($P \leq 0.05$), a LSD post-hoc test was used for multiple comparison. Results were presented as means ± standard deviation.

3. Results and analysis

3.1 Effects of nano-Se on the biomass of two tobacco cultivars

Table 1. Mean values, standard errors and ANOVA results (p-value) of dry weight (DW) of shoots, roots, and whole plant. Means showing the same letter are not significantly different (P =0.05) in the LSD test.

Cultivars	Se concentration (mg L^{-1})	DW of shoots (g)	DW of roots (g)	DW of whole plant (g)
E'yan 1	0	0.22±0.013b	0.035±0.002b	0.25±0.012b
	2.5	0.24±0.027a	0.040±0.001b	0.29±0.028b
	5.0	0.26±0.010a	0.048±0.006a	0.31±0.015a
K326	0	0.21±0.015b	0.040±0.002b	0.25±0.017b
	2.5	0.29±0.025a	0.056±0.005a	0.36±0.024a
	5.0	0.23±0.013b	0.050±0.006a	0.28±0.017b

Compared to the control, both concentrations of nano-Se treatment increased the shoot, root and whole plant dry weight (DW) of the two tobacco cultivars

3.2 Effects of nano-Se on antioxidant enzyme activities and oxidative molecules contents in different tobacco cultivars

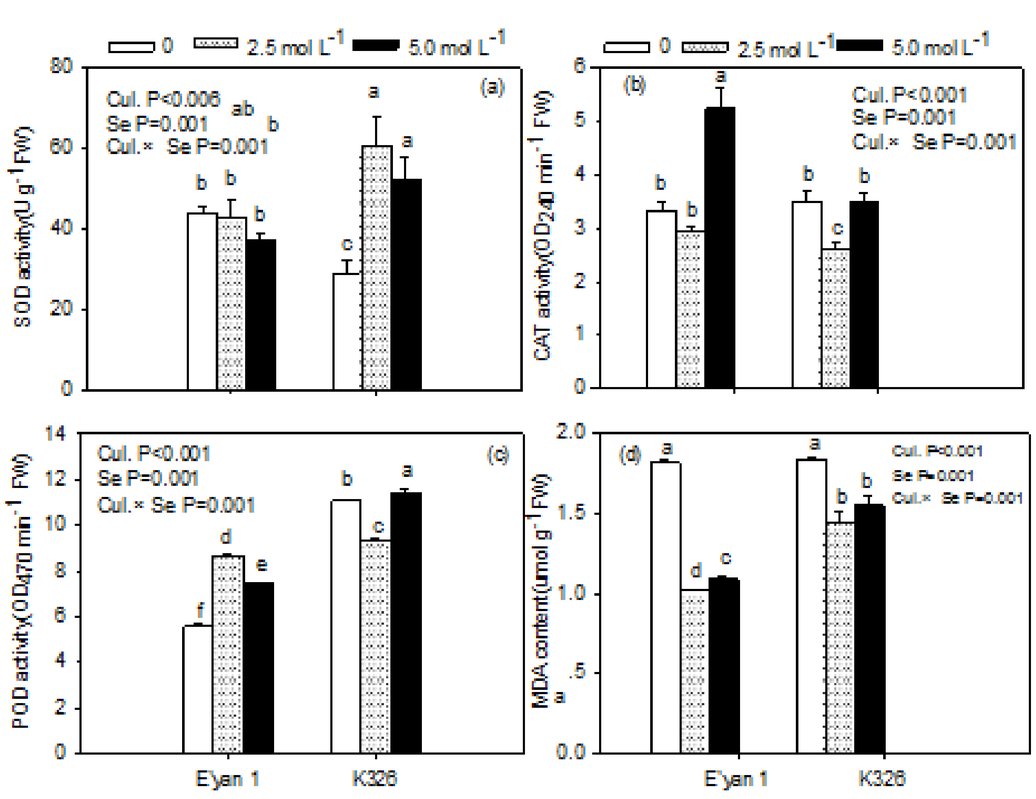

Figure2. SOD activity (a), CAT activity(b),POD activity(c), MDA content(d), in tobacco leaves of E'yan1 and K326, sprayed with nano-Se concentrations of 0, 2.5 and 5.0 mg L-1. Means showing the same lower case letter are not significantly different (P =0.05) in the LSD test.

There was significant cultivar, nano-Se concentration, and cultivar × nano-Se interaction effects for superoxide dismutase (SOD), peroxidase (POD) and catalase (CAT) activities.

4. Conclusions

The plant growth of tobacco can be promoted by spraying nano-Se at appropriate concentration on the leaf surface, but there is a concentration effect. Different tobacco cultivars have different degrees of response to nano-Se, and E'yan 1 is more tolerant than K326. Nano-Se can improve the antioxidant enzyme activities of two tobacco cultivars and reduce the content of membrane lipid peroxidation products and ROS.