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ACTIVITIES OF ENZYMES OF AMINO-ACID METABOLISM IN *PENNISETUM* SEEDLINGS GROWN IN THE PRESENCE OF 2-CHLOROETHYLPHOSPHONIC ACID

NARENDRA SANKHLA* and WILFRIED HUBER

Botany Department, Technical University, D-8000 Munich 2, W Germany

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Abstract—The plant growth regulator 2-chloroethylphosphonic acid (CEPA) slightly inhibited the elongation of growth in *Pennisetum typhoides* seedlings, but greatly stimulated the activity of alanine aminotransferase (GPT), asparate aminotransferase (GOT), as well as glutamate dehydrogenase (GLDH).

INTRODUCTION

2-CHLOROETHYLPHOSPHONIC acid (CEPA) is well known for its effects on seed germination, growth, flowering, maturation and abscission of fruit and leaves, and latex yield.[1-6] The purpose of the present study was to investigate the effect of CEPA on the growth and the activity of some of the key enzymes of amino-acid metabolism in *Pennisetum* seedlings.

RESULTS

Growth

With an increase in concentration CEPA significantly decreased the growth of *Pennisetum* seedlings (Table 1). Even as low concentration as 60 ppm CEPA retarded the elongation growth both of roots and the first foliage leaf. The elongation of the coleoptiles was not affected at 60 ppm, but was markedly reduced at higher concentrations in comparison to control.

Alanine aminotransferase (GPT)

In contrast to growth, the activity of GPT in extracts of seedlings grown in the presence of CEPA was found to be significantly higher than that of control plants. With an increase in the concentration of CEPA the activity of this enzyme also elicited a large increase. Thus, in comparison to the control, the mean activity of GPT increased by about 68, 88,

* Permanent address. Department of Botany, University of Jodhpur, India

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TABLE 1 EFFECT OF CEPA ON SEEDLING GROWTH OF *Pennisetum typhoides*

Treatment	Seedling growth (mm) after 4 days		
	Root	Coleoptile	Leaf
Control	55	12	44
CEPA 60 ppm	18	12	25
CEPA 120 ppm	15	10	25
CEPA 240 ppm	10	10	20
CEPA 480 ppm	10	8	15

140 and 154% in the extracts of the seedlings grown in the presence of 60, 120, 240 and 480 ppm CEPA respectively.

Aspartate aminotransferase (GOT)

As in the case of GPT, the extracts of the seedlings grown in the presence of CEPA indicated a clearcut increase in the activity of GOT; the magnitude of the response, however, was a smaller one By comparison to the control, the activity of GOT increased only by about 32, 47, 52 and 70% in the presence of 60,120, 240 and 480 ppm CEPA respectively

Glutamate dehydrogenase (GLDH)

Like that of GPT and GOT, CEPA also stimulated the activity of GLDH With an increase in the concentration of CEPA tested a corresponding stimulation in the activity of this enzyme was also clearly evident. Thus, the activity of GLDH increased by about 16, 32, 43 and 95% in the presence of 60, 120, 240 and 480 ppm CEPA respectively. The activation of the above enzymes by CEPA was found to be valid even if expressed on a per plant basis

DISCUSSION

CEPA decomposes in plant tissue to release ethylene.[7,8] Therefore, it may be assumed that ethylene liberated from the chemical is responsible for its effects The inhibition of growth of *Pennisetum* seedlings in the presence of CEPA may thus arise from the combined effects of ethylene on cell division and expansion [9] Since inhibition of growth following treatment with ethylene is accompanied by reduction in the amounts of both diffusible and extractable auxin content, it may be that growth reductions in part mediate through the effect of the gas on auxin economy of the plants [9] This contention is supported by the fact that in *Vicia* simultaneous application of auxin with ethylene maintains growth at a control level [9,10]

It appears that the activity of aminotransferases can be regulated by several factors, including plant growth regulators Thus, Hedley and Stoddart[11-13] observed that in *Lolium* leaves while the activity of GPT was influenced by illumination, daylength and hormone level, the activity of GOT remained insensitive to these parameters. Earlier we

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observed that when seeds of *Pennisetum* were germinated in the presence of sodium chloride or abscisic acid, the activity of GPT was greater than that of plants germinated in water.[14,15] The results of the present investigation indicate that CEPA can also regulate the activity of aminotransferases.

Glutamate dehydrogenase catalyzes the reductive amination of α-ketoglutarate to glutamic acid,[16] so that increased GLDH activity suggests more synthesis of amino-acids, which, in turn, results in more protein synthesis. The increased activity of GLDH in *Pennisetum* seedlings grown in the presence of CEPA are in accordance with the earlier results, where this chemical has been shown to enhance the rates of synthesis of ribosomes, RNA and protein.[9,17] It is possible that, as suggested earlier,[9] in *Pennisetum* ethylene also affects RNA and protein metabolism in order to bring about alterations in the growth of seedlings However, this remains to be tested.

EXPERIMENTAL

As described earlier[14,15] seedlings of *Pennisetum typhoides* (Burm f) Stapf & Hubbard were raised in 9 cm Petri dishes lined with a single layer of filter paper moistened with 5 ml of the test soln The test solution consisted of desired concentrations (60, 120, 240 and 480 ppm) of 2-chloroethylphosphonic acid (CEPA) obtained through the courtesy of C F Spiess & Sohn, Germany

For enzyme assay the aerial parts obtained from four day old seedlings were used The test mixtures and the procedures for enzyme assay were the same as described previously [14,15] However, the enzyme activities were calculated on the basis of μM NADH reduced/g fr. wt , and have been represented as a percentage of the control value The experiments were performed at least four times, and the data, wherever possible, analyzed statistically using *t*-test

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