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FATfY ACID AND STEROL COMPOSITION OF WHEAT AS AFFECTED BY SALINny AND THE PLANT GROWTH REGULATOR, DINICONAZOLE

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The effect of Triazole (Diniconazole) growth regulator on wheat growth and composition of fatty acids and sterols was studied under saline hydroponic conditions. Diniconazole (DINI) reduced both shoot and root lengths but shoot growth was affected more drastically than root growth. Levels of unsaturated fatty acid (oleic, linoleic and linolenic) declined with both salinity and DIN!. Salinity did not affect the. sterol composition while DINI enhanced the levels of sitosterol and decreased the levels of stigmasterol. The role of fatty acids and sterols in salt-tolerance is discussed.

INTRODUCTION

Diniconazole (DINI) is a triazole fungicide that has growth regulatory activity in plants. Other compounds belonging to this class of chemicals are known to increase stress resistance in plants to various bnvironmental extremes' i.e. chilling, heat, air pollutants and drought (Fletcher and Hofstra, 1988). Triazoles have also been reported to inhibit sterol synthesis in higher plants (Lurssen, 1988) as well as cause an increase in unsaturated and free fatty acids in fungi (Sisler and Ragsdale, 1984). Such effects could alter membrane characteristics to the extent that permeability changes might be affected thus altering the plants resistance to stress. The objective of the study reported here was to determine if DINI treated seeds of wheat could better tolerate NaCl stress than non-treated controls and determine if changes in sterol and fatty acids occurred as a result of such treatments.

MATERIALS AND METHODS

Wheat seeds (variety Verne) were soaked in 3.1% DINI (Fig. 1) suspension (with distilled water as a control) for 24 hours prior to placing in verrniculitc for germination. Ten-day seedlings were transferred to half strength Hoagland's solution. After one week, half of the plants were subjected to salt stress (150 mM NaCI) for 72 hours and harvested. The methods for extraction and analysis of sterols and fatty acids are summarized in Fig. 2.

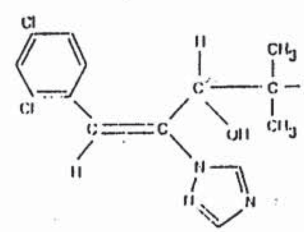

Fig. 1. (E)-1-(2, 4-dichlorophenyl)-4, 4-dimethyl-2-(1, 2, 4-triazol-1-yl)-1-pentene-3-ol

500 mg fresh tissue
(Add internal stds.)

Extract with 16% KOB in 80% MeOB
(2 hours at 70°C)

Partition 3x with hcxanc:cthcr (I: I)

Top layer (hexane:ether)
(Sterols)

Evaporate under N,

From TMS denvanves
(Bistrimethylsilyl acetamide)

Analyze hy GLe

Bottom layer (Aqueous)
(Fatty acids)

Acidify with 6 N HCI

Form methyl esters
(Bel,-MeOIl)

Partition 3x with hexane

Analyze by GLC

Fig. 2. Extraction and analysis procedure.

Table 1. Shoot and root growth of wheat as affected by salinity (150 mM NaCI) and the plant growth regulator diniconazole

Treatment	Length (cm)		Fresh weight (g plant⁻¹)	
	Shoot	Root	Shoot	Root
Control	20.3 ± 2.9	26.7 ± 2.5	0.30 ± 0.09	0.40 ± 0.12
Salinity	20.3 ± 0.5	23.7 ± 0.9	0.30 ± 0.08	0.50 ± 0.08
Diniconazole	10.6 ± 1.3	20.7 ± 1.7	0.28 ± 0.04	0.30 ± 0.04
Salinity + Diniconazole	8.3 ± 0.5	17.3 ± 2.6	0.12 ± 0.02	0.12 ± 0.01

RESULTS

DINI treated seeds resulted in seedlings having decreased shoot and root lengths (Table 1). The combined effect of salinity and DINI was more detrimental than either separately. Root lengths were not affected as drastically as were shoot lengths in the DINI treatments. Fresh weights (Table 1) were reduced in the DINI and DINI + salinity treatments for both roots and shoots. Salinity stress only had no detectable effects on fresh weights of either roots or shoots.

Unsaturated fatty acid levels (18:1, 18:2 and 18:3) declined in all treatments in order of salinity + DINI > DINI > salinity (Table 2).

creased levels of sitosterol and reduced levels of stigmasterol (Table 3). Total sterol was also highest in these treatments.

DISCUSSION

Reductions in unsaturated fatty acids could possibly decrease the fluidity of bio-

Table 2. Fatty acid levels in wheat shoots (P.g gol I'W) as affected by salinity (ISO mM NaCI) and the plant growth reguhitor dtnieenazole

Treatment	Fatty acids						
	14:0	16:0	16:1	18:0	18:1	18:2	18:3
Control	14 ± 3	1078 ± 71	248 ± 17	20± 8	123 ± 28	1379 f 198	5385 ± 3W
Salinity	15 ± 4	1013 ± 59	251 ± 35	39 ± 8	81 ± 10	982 ± 51	5128 ± 388
Diniconazole	8±3	782 ± 38	212 ± 17	28 ± 6	88 ± 15	759 ± 32	4800 ± 466
Salinity + Diniconazolc	10 ± 1	664 ± 42	127 ± 33	27± 6	.29 ± 8	664 ± 60	3737 ± 437

Table 3. Sterol levels in wheat shoots (gig FW) as affected 'by salinity (ISO mM NaCI) and the plant growth regulator diniconawlc

Treatment	Sterols			
	Cholesterol	Capesterol	Stigmasterol	Sitosterol
Control	635 ± 86SD	51 ± 3	63 ± 1	175 ± 5
Salinity	583 ±171	48 ± 8	56 ± 3	157 ± 14
Diniconazole	990 ±464	70 ± 2	47 ± 1	278 ± 89
Salinity + Diniconazole	645 ± 73	70 ±12	46 ± 9	233 ±36

The principle sterols in wheat were cholesterol, campesterol, stigmasterol and sitosterol. Sixty-five to 71% of the total sterol was cholesterol with sitosterol being the next most abundant (18.9-23.4%). Salinity had little effect on the sterol composition in wheat leaves, however, the DINI and DINI + salinity treatments resulted in in-

logical membranes resulting in increased permeability. Sterols are known to be inserted between phospholipids which comprise the bilayer of cell membranes increasing stability and resulting in a more rigid and less permeable membrane. DINI treatments resulted in an increase in total free sterol concentration which may be a response to the decreased level in unsaturated fatty acids observed. Plants subjected to increased salinity were observed to have a reduction in both unsaturated fatty acids and free sterols. It appears that when unsaturated fatty acid is low i.e. DIN! and DINI + salinity, the sterol .level increases (same treatments). Previous studies in which different root stocks of citrus were exposed to high saline conditions, increased ratios of stigmasterol to sitosterol occurred (Douglas and Walker, 1983) which was related to the ability of saline resistance root stocks to exclude salt. However, in the present study, this ratio declined and may reflect the differences in the tissues analyzed i.e. shoot rather than root. The significance of changes in ratios of plant sterols has been suggested to be related to their ability to be readily incorporated into cell membranes. Generally, stigmasterol is viewed as being more readily incorporated than sitosterol.

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