THE EFFECTS OF CYCOCEL (CCC) ON TOMATO UNDER WATER STRESS

by

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Thesis submitted for the Degree of
Master of Agricultural Science

December, 1983.

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STATEMENT

This thesis has not been previously submitted for a degree at this or any other University, and is the original work of the writer except where due reference is made in the text.

(SOLOMON AMOABIN)

ACKNOWLEDGEMENTS

I wish to express my sincere thanks to Professor L.G. Paleg for his guidance, constructive criticisms and encouragement in the course of the programme. I am also grateful to Dr. D. Aspinall for acting as a second supervisor.

I am also indebted to Dr. C.F. Jenner for his guidance during the absence of my supervisors, and also to Dr. P.E. Kriedemann for his invaluable advice. I am also grateful to Dr.T.J. Douglas for his help and advice during my early days in Australia. My sincere thanks also go to the technical staff and all the other members of the Department of Plant Physiology for their cooperation and help in diverse ways.

I am grateful to Carol Amoabin who helped in typing and showed a lot of patience and understanding during the preparation of this thesis.

Finally, the financial support provided by the Commonwealth Scholarship and Fellowship Plan and the extra support from The University of Adelaide are gratefully acknowledged.

SUMMARY

CCC (2-chloroethyltrimethyl ammonium chloride) a synthetic plant growth retardant, has been previously found to increase the resistance of various plants to drought. Work done on this subject mostly attributes the CCC effect to reduced leaf area and increased root/shoot ratios due to the retardation of shoot growth though there are a few cases where CCC did not retard shoot growth but still induced drought resistance. A few workers have mentioned the involvement of CCC-induced stomatal closure in the drought resistance of CCC-treated plants. Some workers have associated the CCC-induced drought resistance with metabolic changes of CCC per se, and CCC-mediated metabolic changes in plants under water stress, without mentioning how these changes are related to the CCC-induced drought resistance.

This study was conducted to determine whether CCC affected the drought resistance of tomato, which is relatively sensitive to water stress, and, if so, to explore some of the possible mechanisms underlying the effect. Attention was directed towards the effects of CCC on the tomato plants under stress independent of its retardation effect on growth.

At a concentration of 1000ppm, CCC retarded the growth of the tomato plants 6 days after its application as soil drench. CCC reduced height, leaf area, fresh and dry weights of leaves and stem, without any retardation effect on root growth, resulting in an increased root/shoot ratio. Whether CCC retarded the growth of the plant or not before inducing water stress, the CCC-treated plants maintained higher water potential especially within the first few days after with-holding water, such that they did not wilt as quickly as the non-CCC-treated plants. Despite this prolonged survival under water stress due to CCC treatment, growth was not sustained. When PEG was used to induce stress, CCC did not have any effect on water potential and it could not reduce the toxic effect of PEG, in the form of leaflet margin chlorosis.

Under soil water depletion induced by with-holding water from the plants, RWC was higher in the CCC-treated plants but osmotic potential did not decrease as much in the CCC-treated plants as the non-CCC-treated plants. The relationships between water potential and RWC, osmotic potential and turgor potential were not altered by CCC which indicated that CCC did not enhance the treated plants' ability to adjust osmotically. This was supported by the apparent lack of effect of CCC treatment in promoting solute accumulation.

In normal well-watered plants, CCC caused a rapid differential increase in adaxial leaf diffusive resistance but not in abaxial resistance indicating a CCC-induced closure of the adaxial stomata, independent of its effects on growth.

This was consistent with a marked decrease in transpirational water loss from the adaxial leaf surface of the CCC-treated plants. Water stress *per se* (induced by with-holding water from the plants) also caused stomatal closure but this was quicker in the non-CCC-treated plants than in the CCC-treated plants. The same water potential threshold was found for stomatal closure and effective control of further water loss under stress, and this was unaffected by CCC. This indicated that, because of the initial CCC-induced adaxial stomatal closure and the concommitant reduced transpiration, the water potential of the CCC-treated plants declined less rapidly as the stress progressed, and that the time required to reach the water potential threshold for stomatal closure and effective control of water loss was prolonged by the CCC treatment.

It was concluded that, independent of its growth retardation effect, CCC enabled plants to delay the onset of severe internal water deficit and, therefore, prolonged survival through CCC-induced adaxial stomatal closure and the attendant decreased transpirational water loss. This did not seem to involve any CCC-induced osmotic adjustment. When CCC retarded growth, however, the increased root/shoot ratio and the reduced leaf area could be additional factors contributing to the CCC-induced resistance to water stress.

ABBREVIATIONS AND SYMBOLS

ABA	abscicic acid
ATP	adenosine triphosphate
^{14}C	radioactive carbon
Ca	calcium
°C	degrees centigrade
CCC	cycocel
cm	centimetre(s)
cm^2	square centimetre(s)
CO_2	carbon dioxide
D_2O	deuterium oxide
dm^2	square decimetre(s)
F.C.	field capacity
Fig.	figure
g or gm	gram(s)
H^+	hydrogen ion
HCl	hydrochloric acid
H_2O	water
hr(s)	hours
i.e.	that is
ins.	inches
K	potassium
K^+	potassium ion
KCl	potassium chloride
kg	kilogram(s)
l	litre(s)
MeOH	methanol
Mg	magnesium
M.W.	molecular weight
MWC	methanol : chloroform : water
$\mu E.m^{-2}s^{-1}$	microeinstein per square metre per second
µg	microgram(s)
µl	microlitre(s)
mg	milligram(s)
ml	millilitre(s)
mm	millimetre(s)

N_2	nitrogen
N	normal
NMR	nuclear magnetic resonance
No.	number
P	phosphorus
^{32}P	radioactive phosphorus
PEG	polyethylene glycol
ppm	parts per million
^{86}Rb	radioactive rubidium
rpm	revolutions per minute
RWC	relative water content
Sec.	second(s)
Si	silicone
t	time
t-buOH (tert-BuOH)	tertiary butanol
Δt	change in time
>	greater than
%	percent
ψ	water potential
ψ_s	osmotic (solute) potential
ψ_p	turgor potential
ψ_m	matric potential

FIGURES

APPENDIX FIGURES

TABLES

APPENDIX TABLE