TABLE I

Carbofuran residues in brinjal

Time lag after application (days)	Dose of furadan 3G (g/plant)	Residues of Carbofuran (ppm)
7	1	0·088
	3	0·097
	10	0·171
21	Control	Traces
	1	0·055
	3	0·076
	10	0·099
37	Control	N.D.
	1	0·021
	3	0·040
	10	0·045
52	Control	Traces
	1	0·020
	3	0·057
	10	0·064
75	3	Traces
	10	0·027
58	3 (raw)	0·021
	3 (cooked)	N.D.
	10 (raw)	0·074
	10 (cooked)	N.D.

N.D. = Not detectable.

The authors are grateful to the Director, F and P, Rallis India Limited, for permission to publish this note.

Research and Development Laboratories, Rallis India Limited, Fertilisers and Pesticides Division, Bangalore 560 025, India,
August 23, 1978.

M. S. MITHYANTHA.
T. B. GOUR.
S. C. TRIPATHI.
V. AGNIHOTHRUDU.
D. S. KULKARNI.

* Furadan is the registered trade mark of FMC Corporation for Carbofuran.

1. Anonymous, *Rallis Agricultural Information Service*, 1977, **28** and **29**.
2. Gupta, R. C. and Dewan, R. S., *Proc. First All India Symp. Progress and Problems in Pesticides Residue Analysis, Ludhiana*, 1971, p. 208.
3. Bhattacharjee, N. S. *et al.*, *Entomologists Newsletter*, 1975, **5**, 42.

THE EFFECT OF PRE-SOWING HARDENING AND FOLIAR APPLICATION WITH GROWTH REGULATORS IN ORACH (*ATRIPLEX HORTENSIS* L.)

Introduction

THE pre-sowing hardening and foliar application with growth regulators are known to result in early emergence[2], enhanced growth rate[1–3, 5], and increased yield[3, 7]. Studies were undertaken on orach (*Atriplex hortensis* L.) a common leafy vegetable, to determine the efficacy of seed hardening and foliar application with indole-acetic acid (IAA), gibberellic acid (GA_3), (2-chloroethyl) trimethyl ammonium chloride (CCC), kinetin, (2-chloroethyl) phosphonic acid (ethrel), and ascorbic acid (AA).

Experimental

The seeds of orach obtained from Kissan Seeds Corporation, Bangalore, were subjected to 3 cycles of hardening with distilled water and 25,100,250 and 500 ppm each of GA_3, ehrel, CCC, AA and 100 and 500 ppm of Kinetin. Each cycle was constituted of 3 h soaking in the respective media followed by 40 h air-drying to the original weight. The treatment was given under laboratory conditions of light and temperature (26° to 28° C). The treated seeds were set for germination in petri dishes of 10 cm. dia. lined with moist blotters in 5 replications of 10 seeds each. The unhardened seeds were used as control. The mean maximum and minimum temperatures during test period were 28° C and 25° C respectively and mean relative humidity was 52%. Data on the length and dry weight of root and shoot and reducing sugar content by DNS method (Clark J. M.)[4], of 72 h old seedlings were recorded. In another trial orach seeds were hardened with 20 and 200 ppm of GA_3, kinetin, ethrel, and IAA each in 3 cycles. Each cycle consisted of 4 h soaking and 40 h air drying. Water hardened and unhardened seeds were also included in the experiment for comparison. Plants were raised in 1·8 × 1·2 meters plots in Lalbagh, Bangalore, in five replications of nine plants each in randomized block layout. The mean maximum and minimum temperatures during the test period were 28·4° C and 19·7° C respectively and the mean relative humidity was 68%. Data on dry weight of root and shoot systems of the 15-day old and 30-day old plants were recorded.

20-day old plants of orach grown in 1·8 × 1·2 meters plots in Lalbagh, were given a foliar spray with GA_3, kinetin, AA and CCC each at 25 and 250 ppm. Other details were as for the above field trial. The maximum and minimum temperatures were 28·4° C and 16·3° C respectively and mean relative humidity was 60%. The dry weight of shoot and root of the 35-day old plants was recorded.

Results and Discussion

The data in Fig. 1 reveal that the treatments caused an increase in root length of 72 h old seedlings, except for a decrease seen in treatments with water, kinetin and ethrel (- 25 ppm). Treatment with water, GA_3, CCC, AA (the latter three at 25 and 250 ppm) and ethrel at 25 ppm caused an increase in shooot length.

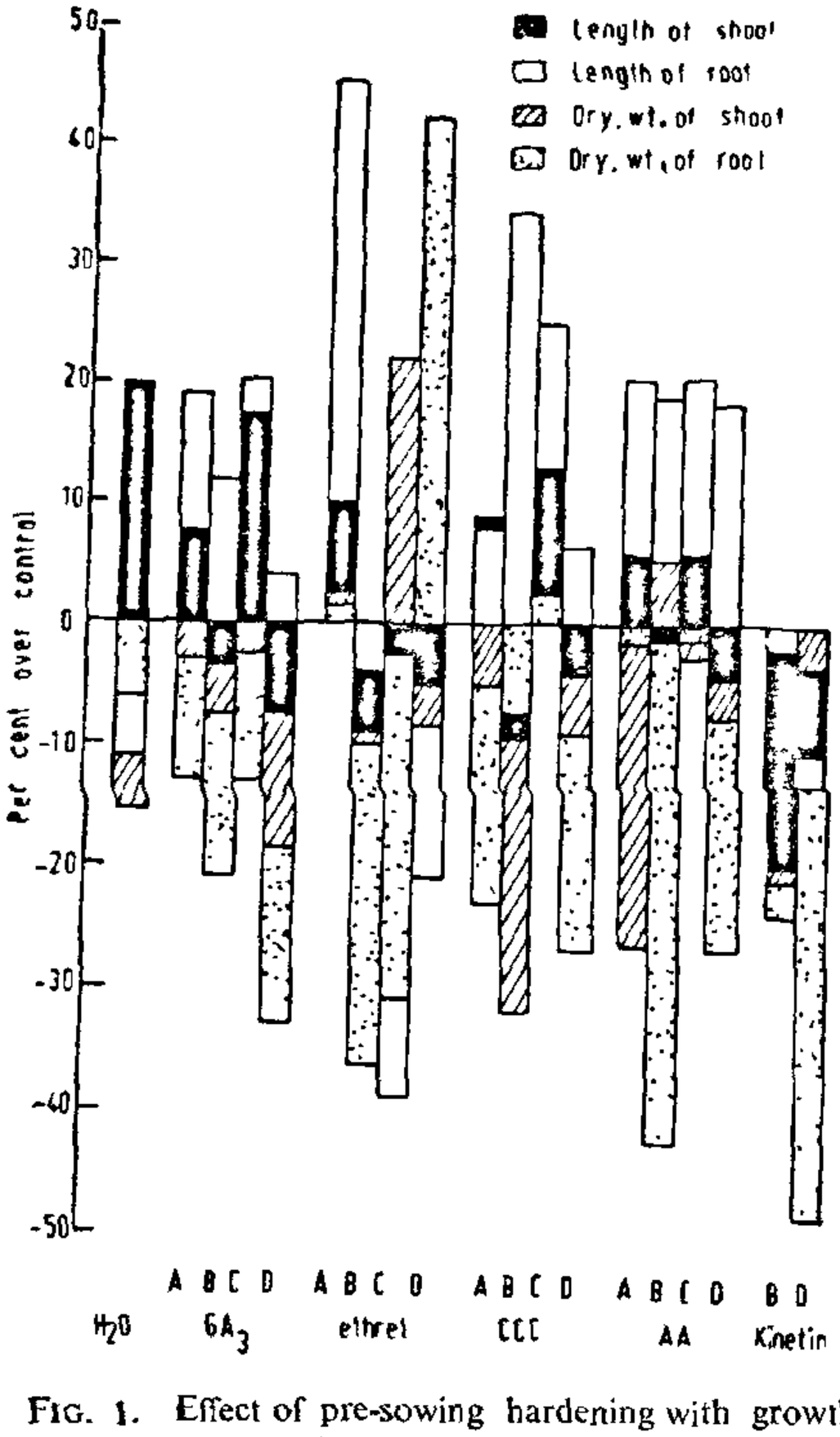

FIG. 1. Effect of pre-sowing hardening with growth regulators on length and dry weight of 72 h old seedling of *Atriplex hortensis* L. A—25 ppm; B—100 ppm; C--250 ppm; D—500 pmm.

Mullick[8] has also reported the promotory effect of GA_3 (250 ppm) on the shoot length in *Rhynchosia* spp. In the present trial, though GA_3 treatment caused an increase in shoot length the promotory effect was not evident in the dry weight of the seedlings. Other seed treatments caused a decrease in the shoot length. With ethrel, considerable increase in shoot dry weight (at 25 and 250 ppm) and root dry weight (25 and 500 ppm) were registered. CCC (250 ppm) and AA (100 ppm) caused a slight increase in the root dry weight (3%) and in shoot dry weight (6%), respectively. Except ascorbic acid treatment, which caused 8% increase in the reducing sugar content of the seedlings, all others caused 5 to 10% decline.

Pre-sowing hardening had no effect on the seedling emergence. In all the treatments, the seedlings emerged on 5th day from the date of sowing. The commencement of flowering on the 36th day, was also uninfluenced by the treatments.

As seen in Table I, the 15-day and 30-day old plants raised from seeds treated with ethrel (200 ppm), GA_3 (200 ppm) and IAA (20 ppm) showed an increase in the dry weight of both root and shoot systems; ethrel was most effective in this regard though the inhibition caused at 20 ppm cannot be explained. IAA (200 ppm) proved inhibitory. Increase in shoot and root dry weight of 15-day old seedlings with kinetin (200 ppm) and decrease in the root dry weight with IAA (200 ppm) are comparable in trend to that reported by Kanchan[9].

FIG. 2. Effect of foliar application of growth regulators in *Atriplex hortensis* L. a—25 ppm; *b*—250 ppm

TABLE I

Influence of pre-sowing hardening with growth regulators on the growth of 15-*day and* 30-*day old plants of* Atriplex hortensis L.

Treatment	Concentration (ppm)	15-day old plants		30-day old plants	
		Dry wt. (% over control)		Dry wt. (% over control)	
		Root	Shoot	Root	Shoot
H_2O		*+ 25	*— 13·23	— 55·56	— 58·13
	20	+ 25	+ 14·81	— 24·44	— 20·77
GA_3	200	+ 25	+ 30·16	+ 40·74	+ 52·78
	20	+ 83·33	— 15·34	— 60	— 50·72
Kinetin	200	+ 41·67	+ 32·28	— 36	— 30·43
	20	+ 50	+ 24·87	+ 10·34	+ 9·94
IAA	200	— 16·67	— 29·1	— 57·14	— 57·56
	20	— 25	— 4·76	— 30	— 20·29
Ethrel	200	+ 175	+ 104·76	+ 1077·78	+ 9·5

*+ and — stand for promotion and inhibition respectively.

Foliar application of growth regulators caused an increase in the dry weight of root and shoot systems (Fig. 2). GA_3 (250 ppm) abd CCC (25 pppm) brought about slight decline in the dry weight of shoot system. Increase in the plant dry weight with AA treatment was also observed by Chinoy *et al.*[3] in *Trigonella foenum-graecum* (AA 200 ppm) and *Brassica chinens* (AA 400 ppm). The promotory effect of GA_3 (25 ppm) and CCC (250 ppm) show a trend similar to that observed by Linser and Zeid[6] in *Daucus carota.*

None of the foliar treatments in the present study influenced the commencement of flowering.

Seed hardening treatments of orach seeds with ethrel (25 ppm) and CCC (250 ppm) showed an increase in the length and dry weight of 72 h old seedlings by 10 to 45% , whereas GA_3 (25 and 250 ppm), CCC (25 ppm) and AA (25 and 250 ppm) showed an increase in the length by 10 to 25% but not the plant dry weight. Kinetin (100 and 500 ppm) treatment showed an inhibition of growth by 20 to 45%. Hardening with ethrel (200 ppm), GA_3 (200 ppm) and IAA (20 ppm) increased the dry weight of 15-day and 30-day old plants over the range to 10 to 1000%. Foliar application treatments of 20-day old plants with CCC, GA_3, kinetin and AA (each at 25 and 250 ppm) increased plant dry weight by 10 to 65% whereas the shoot dry weight was decreased by 3 and 8% in CCC (25 ppm) and GA_3 (250 ppm) treatments respectively.

From the foregoing results it may be inferred that the crop responds positively to most of the growth regulators tested and foliar application was most effective.

Grateful thanks are due to Dr. Jayachandra for the guidance and to Prof. Nagaraj, Head of the Department of Botany, for providing the laboratory facilities and encouragement. Thanks are due to the authorities of Lalbagh, Bangalore, for providing space for conducting field trials. The financial help from CSIR is also acknowledged.

Department of Botany, D. N. SARASWATHAMMA.
Central College, Bangalore,
August 31, 1978.

1. Abdel Hafez, A. T. and Hudson, J. P., *Nature*, 1967, p. 216.
2. Austin, R. B., Long den, P. C. and Jane Hutchinson, *Ann. Bot.*, 1969, **33**, 883.
3. Chinoy, J. J., Nanda, K. K. and Garg, O. P., *Physiol. Plant*, 1957, **10**, 869.
4. Clark, J. M. Jr. (ed.) *Experimental Biochemistry*, W. H. Freeman and Co., San Fransisco and London. 1964.
5. Kauf, B. K. and Kapoor, L. D., *Planta Medica*, 1962, **10**, 91.
6. Linser, H. Zeid, F. A., *Bodenkultur*, 1976, **27** (3), 256.
7. Mart 'Yanova, K. L., Gubanova, Z. P. and Zhuritin, V. K., *Fiziol. Rast.*, 1961, **8** (5), 638.
8. Prakash Mullick, *Environ. Physiol. Ecol. Plants*, 1978, p. 407.
9. Sukhada, D. Kanchan, *Curr. Sci.*, 1973, **42** (21), 762.