TABLE I

Chemical	Concentration (ppm)	Retardation in senescence (days)	Chemical	Concentration (ppm)	Retardation in senescence (days)
2,4–D	10, 20	2	Adenine	10, 20	4
	50	4		50, 100	6
	100	2	Benzimidazole	1, 5	18
2,3,5–T	10, 20	2		10, 20	16
	50	6		50	24
	100	2		100	20
IAA	1.5	6	CCC	1 to 100	Augmented
	10, 20, 50, 100	2			
IBA	20, 50	6	Nickel chloride	5 to 100	Promoted
GA_3	5, 10	4			
	20	8			
	50, 100	16			

2,4–D—2,4–dichlorophenoxyacetic acid; 2,3,5–T—2,3,5–trichlorophenoxyacetic acid; IAA—β–Indolylacetic acid; IBA—β–Indolylbutyric acid; GA_3—Gibberellic acid; CCC—2–chloroethyltrimethyl ammonium chloride.

The results show that of all the chemicals under study, benzimidazole is most effective in inducing retardation of senescence. This corroborates the effects of BZI on rice[2,6,11], wheat[8,10] and *Hibiscus*[4]. The next in effectiveness is GA_3. The present findings are in agreement with the findingss of Brian *et al*[1]. Third in the grade is adenine. This confirms the results on rice[11] previously reported. The effects of the two herbicides, 2,4–D and 2,4,5–T, are very mild; this finds corroboration in the work of Osborne[7]. The two auxins, IAA and IBA, also had perceptible effectss on retardation of senescence. The effect of the growth retadant, CCC, is entirely contrary to the action of benzimidazole and gibberellic acid on this species. CCC, however, brought about slight retardation in senescence in groudnut[2], *Hibiscus*[4] and *Ervatamia*[5].

Similar is the effect of nickel chloride which brought about an acceleration of senescence. This is a contrast to the effect of nickel chloride on the retardation in senescence in wheat[10] and rice[3].

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1. Brian, P. W., Petty, J. H. P. and Richmond, P. T., *Nature*, 1959, **183**, 58.
2. Mishra, D. and Misra, B., *Z. Pflanzenphysiol.* 1968, **58**, 207.
3. — and Kar, M., *Phytochem.*, 1973, **12**, 1521.
4. Misra, G. and Biswal, U. C., *Bot, Gaz.* 1973, **134**, 5.
5. — and —, *J. Indian bot. Soc.*, 1974, **53**, 65.
6. —, and Hota, J., *Ibid.*, 1977, **56**, 57.
7. Osborne, D. J., *Nature*, 1959, **183**, 1459.
8. Person, C., Samborski, D. J. and Forsyth, F. R., *Ibid.*, 1957, **180**, 1294.
9. Rirchmond, A. E., and Lang, A., *Science*, 1957, **125**, 650.
10. Wang, D. and Waygood. E. R., *Can. J. Bot.*, 1959, **37** 743.
11. Yamada, N., Suge, H., Nakamura, H. and Tazima, K., *Crop Sci. Soc. Japan, Proc.* 1964. **32**, 255.

IN VITRO CLONAL PROPAGATION OF CASSAVA

CASSAVA is a vegetatively propagated crop of considerable importance and provides the cheapest and highest calorie yield per acre in Africa, South America and South India[1]. It is also used as a raw material in the manufacture of soap, plywood, paper, acetone, glycerol, glucose and dextrose[2]. It is, therefore, highly desirable to develop methods for its quick, efficient and large scale multiplication. In this regard tissue culture offers[3] a unique method for cloning and preservation of pathogen-free stocks of important germplasm.

This communication summarizes an *in vitro* method for the clonal propagation of plants from stem segments, buds and meristem tips grown on synthetic media.

The stakes of Cassava (Tapioca), *Manihot utilissima* Pohl. CV.M-4 were cut into 10 cm long pieces and planted into pots(Fig.1). Within a week the dormant lateral buds sprouted and later developed shoots. The

excised buds and segments from the young shoots were surface sterilized with 12% solution of Clorox for 15–20 minutes, washed twice with sterile distilled water cultured aseptically.

FIGS. 1–3. Fig. 1. Sprouting of dormant buds from stakes of Cassava 5 weeks after planting. Fig. 2. *In vitro* regeneration of plantlets from 1 cm long shoot segments cultured on modified White's medium supplemented with IAA and kinetin. Fig. 3. Three weeks old culture showing the regeneration of a plant from excised meristems grown on NAA, kinetin and GA enriched medium.

The following cultures were raised on agar solidified modified Murashige and Skoog's[4] (MS) and White's[5] media (WM) supplemented with various concentrations and combinations of IAA, NAA, 2.4–D, GA, and kinetin :

(1) One cm long segments of young shoots
(2) Whole buds (sprout) from stakes 6–8 days after planting
(3) Meristem tip (0·5–1·5 mm) from excised buds.

The shoot segments (Fig. 2) planted on basal WM produced roots at the basal end, and occasionally the dormant bud unfolded to form leaves. Addition of IAA (1 mg/l) + kinetin (0·1 mg/l) encouraged the formation of clusters of roots and sparse proliferation, while 2,4–D (5 mg/l) induced a mass of callus. In general, the segments taken from near the tip of the shoot showed better growth and regeneration as compared to the ones taken from the basal portion.

On MS containing NAA (1 mg/l) + kinetin (0.2 mg/l) + GA (0.5 mg/l)[6] callus was seen to arise at the cut end of the segments[7,8] and the base of the bud and meristem. Shoots were formed from the explants within 2–3 weeks. The *in vitro* regenerated plantlets thus obtained (Fig. 3) continued to grow when transferred to pots.

Since the plants obtained from meristems are virus-free[6,9], it is suggested that meristem tips should be used as a source of primary inoculum, while the segments of young shoots from pathogen-free stocks be employed for the large scale clonal multiplication purposes. The *in vitro* propagation of cassava would also facilitate the international exchange of material by eliminating quarantine inspection.

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1. Nestel, B. L., and MacIntyre, R. (Eds.)., *The International Exchange and Testing of Cassava Germ Plasm in Africa*, Int. Dev. Res. Centre, Ottawa, 1976.
2. Hrishi N., *Ibid.*, Eds., B. Nestel and R. Macintyre. Int. Dev. Res. Centre, Ottawa, 1975,. p. 31.
3. Reinert, J. and Bajaj, Y. P. S. (Eds.) *Applied and Fundamental Aspects of Plant Cell, Tissue, and Organ Culture*, Springer-Verlag, Berlin-Heidelberg, New York, 1977.
4. Murashige, T. and Skoog, F., *Physiol. Plantarum*, 1962, 15, 473.
5. White, P. R., *The Cultivation of Animal and Plant Cells*, Ronald Press. New York, 1963.
6. Kartha. K. K., and Gamborg, O. L., *Phytopathology*, 1975, 65, 826.
7. Prabhudesai, V. R. and Narayanaswamy, S., *Plant Sci. Letters*, 1975, 4, 237.
8. Liu, Ming Chin., *Taiwan Sugar*, Sept–Oct 1975, p. 171.
9. Berbee, F. M., Berbee, J. G. and Hildebrandt, A. C., *In Vitro*, 1973, 8, 421.