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Rooting of Cuttings

Part I — Influence of Growth-Regulating Substances

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During recent years there has been a remarkable expansion of research in the field of plant regeneration by vegetative propagation, the importance of which in horticultural practices cannot be overemphasized. Of the various methods of vegetative propagation in common employment, that by cuttings is at once the cheapest and easiest. Because of a growing belief that all plants can be propagated by means of cuttings, given proper conditions, recent researches have been directed towards determining the optimum conditions conducive to this type of reproduction.

One of the fundamental problems of the propagator is why certain woody-plants can be easily propagated vegetatively while others cannot be so propagated or only with great difficulty. Recent physiological research has to some extent provided an answer to this problem, but a great many details still remain to be worked out. The horticulturist is faced with the question "How can the regenerative capacity of plant cuttings be improved by human intervention"? The efforts of a host of horticultural workers led to the discovery of the growth-regulating substances or plant hormones. The history of these investigations forms a fascinating chapter in botanical research and has been well told by Boysen Jensen (1936) and Went and Thimann (1937). The discovery of these substances was based on the assumption that the meristematic regions of active tissues are centres of production of hormones or growth-regulating substances, but it is now known that they can also be prepared synthetically in the laboratory. These substances are all extremely potent in promoting root-formation when applied to intact plants or plant parts.

Pearse (1939) has given an excellent summary of the work on this aspect. He observes that hormone treatment is effective in the case of cuttings from species which are moderately difficult to root; accelerating rooting in a majority of cases and in causing the production of more roots per cutting. These findings represent a considerable advantage to the practical propagator, in enabling him to clear his propagating beds more quickly and in handling a larger number of cuttings than is otherwise possible. With cuttings which are normally very difficult to root, however, hormone treatment has seldom succeeded in improving root formation to any practical extent. He therefore concludes that in the treatment of cuttings with synthetic root-forming substances, it should be regarded more as a supplement, than as a replacement of the methods normally used by the propagator.

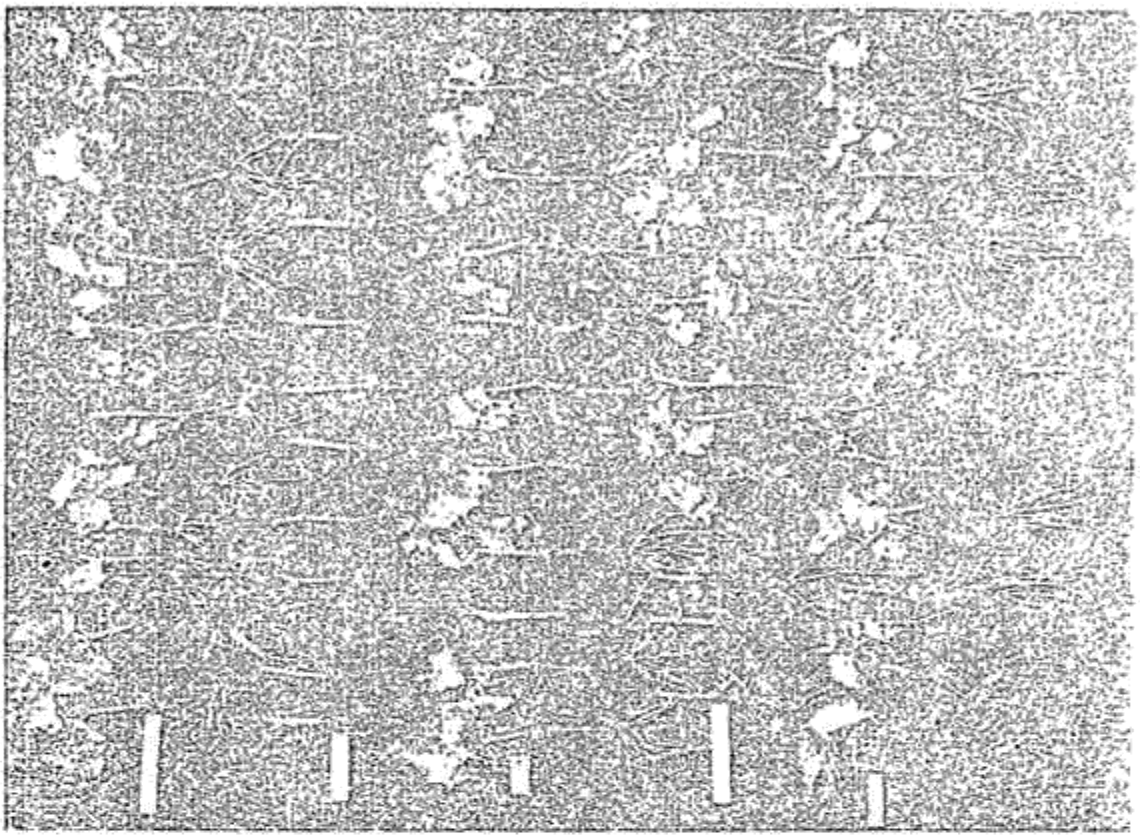

PLATE I

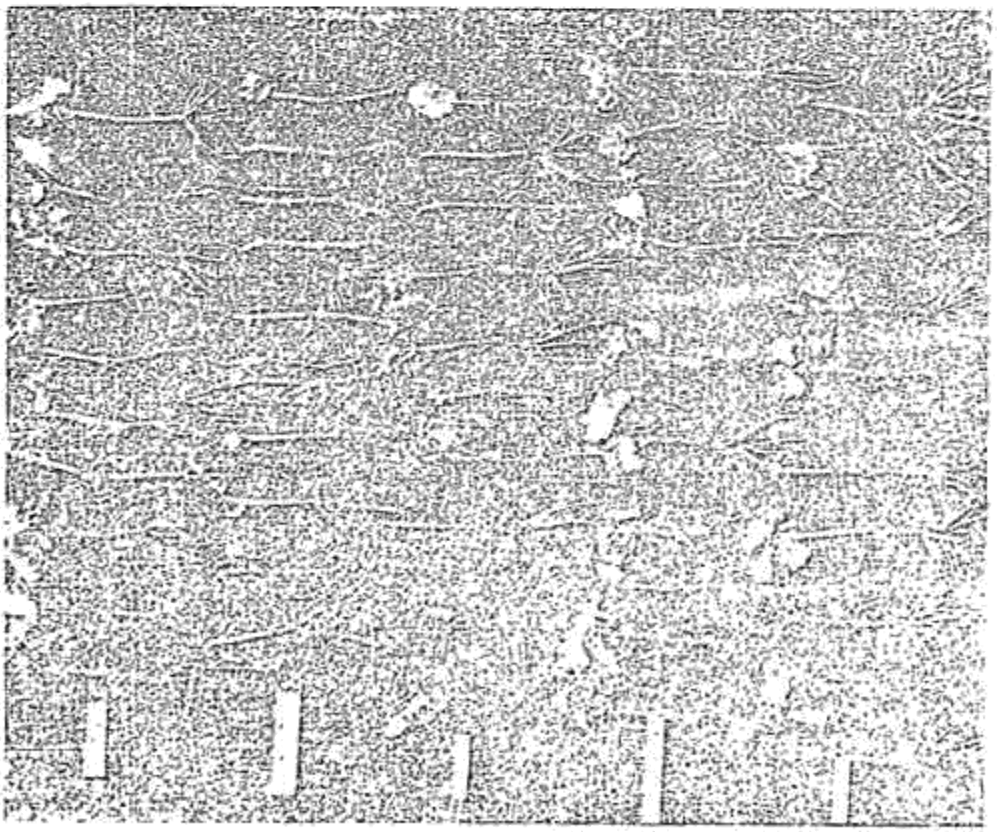

PLATE II

The remarkable expansion of research in this field has resulted in the introduction of innumerable proprietary products in the market, such as 'Seradix', 'Hortomone', 'Hormodin', etc., some of which claim to possess growth 'inducing' properties. With a view to compare the efficacy of these products along with similar chemicals as indolyl-acetic acid, indolylbutyric acid, and phenoxy compounds, small-scale trials were initiated by the author at the College Orchards, Agricultural College, Coimbatore, in May—June 1949. The limitations of time and facilities did not permit a study on a more comprehensive scale and the results of these investigations are therefore subject to confirmation by more extended studies.

Material and Methods: The following substances were tested. 1. 2 : 4 — Dichloro phenoxy acetic acid. 2. β-Indolyl acetic acid. 3. β-Indolyl butyric acid. 4. Hortomone A. 5. Seradix A. 6. Seradix B (3). 7. Potassium permanganate, 8. Cattle urine undiluted. 9. Cattle urine (10%) 10. Water. Stem cuttings of grapevine (*Vitis vinifera*), 'Pachadrakshai' variety, each about a centimeter in diameter were used. These were cut into convenient lengths of six to seven inches with only the lamina of the basal leaves removed. Due attention was paid to the selection of uniform material and subsequent treatments.

Treatments: *2 : 4 Dichloro phenoxy acetic acid, β-indolyl-acetic acid and β—indolyl-butyric acid:* These substances were obtained in the form of crystals and dissolved in a few drops of 95% ethyl alcohol* and diluted to the required degree. A common dose of 100 mg. of the substance per litre of water was tried at the first instance.

Hortomone A and Seradix A:— These are two of the proprietary products recently released in the market. The strengths recommended by the firms were adopted.

Seradix B (3):— This is another proprietary product in the form of a powder.

Potassium permanganate:— A solution of 0·02% potassium permanganate was also included as one of the treatments.

Cattle urine undiluted and cattle urine 10%:— (i) Fresh bullock urine (from the Central Farm, Agricultural College) (ii) same diluted in water ten times.

Water:— Immersion of cuttings in water served as the control.

* The use of alcohol is because of the difficulty in dissolving these substances in water. Pearse (1939) who conducted control tests showed that the small amounts of alcohol present are without effect on the plant material.

Nature of pre-treatment of cuttings:— Ten cuttings were used for each treatment. The cuttings intended for the treatment by the 'Solution method' were immersed in the respective solutions with about $\frac{3}{4}$" of the basal portion immersed for a period of 24 hours, at the end of which, they were rinsed in water and planted in beds (29—5—49).

While the cuttings treated by the solution method were all removed on one day, the batch of ten cuttings treated with Seradix (B), powder, had to be removed from the parent a day later, as it was necessary that the powder had to be applied soon after removal of the cuttings, followed immediately by planting.

Rooting medium:— Raised beds of 4' x $2\frac{1}{2}$' of clean river sand, provided the rooting medium.

Results.

At the end of 60 days, the cuttings were removed from the beds for examination after washing without loss of any roots. The rooting response under each treatment is represented in plates I & II. The number of roots produced by each cutting and the total weight of roots obtained in each treatment, are presented in the appended table.

It is seen from the table and the plates, that of the ten treatments, the following are the most promising in respect of the number of roots prodaced :— 1. Hortomone A, 2. Seradix B (3). 3. Cattle urine 10%, 4. Seradix A and 5. β-indolyl butyric acid.

Considering the weight of roots, the order is as follows :— 1. Hortomone A, (2) Seradix A, (3) B-indolyl butyric acid, (4) Cattle urine 10% and (5) β-indolyl acetic acid.

It is seen from the above that (1) Hortomone 'A' leads the other treatments both by the number and weight at the concentrations used followed by Seradix 'A' and B (3).

(2) The performance of the indolyl compounds are inconsistent at this range of concentration.*

(3) 2 : 4— Dichloro phenoxy acetic acid at 100 mg. per litre and cattle urine (undiluted) are deffnitely lethal.

(4) urine (10%) is promising as a root growth promoting substance.

(5) Cuttings treated with the indolyl compounds and the proprietary products produced roots thicker and shorter, compared to those treated with permanganate, urine and water.

* Seadix 'A' and Seradix (3) are merely two different concentrations of β-indolyl butyric acid, containing 0·48% and 0·8% respectively. Hence it is not surprising that that the performance of the indolyl compounds are in consistent, as 100 grns per litre of the active substance are obviously too high and have proved to be toxic.

(6) Treatment with growth-substances in general produced larger number of roots *.

With a view to test the efficacy of some of the substances on cuttings normally difficult to root, three substances, Seradix A, Seradix B, (3) and Hortomone 'A' were tried on stem cuttings of jack *(Artocarpus integrifolia)*.

Stem cuttings, about a year old were obtained from a bearing tree at the College Orchard, Coimbatore, Batches of ten cuttings were treated with these substances. Examination of the cuttings on the 75th day failed to reveal any sign of root formation, although traces of the powder used were visible even on that date. There was not even an indication of any callus formation. This proved true with a similar batch of cuttings of *(Achras sapota)* tried during the same period.

Discussion.

The superior performance of some of the substances as revealed in these trials may, to some extent, serve as a guide to the practical propagator but it cannot at the same time be said with any certainty that those which have failed to produce any spectacular results are unsuitable. Cattle urine (undiluted) and 2 : 4 Dichloro phenoxy acetic acid, however, have proved to be definitely harmful at the concentrations. Phenoxy compounds have not been very popular as growth-promoting substances, but on the other hand constitute the principal ingredients of growth inhibiting substances. It was however included as one of the substances to test the extent of its activity as compared to other substances like urine.

The abundant root production obtained in cuttings treated with the proprietary products as compared to the less promising results of the other substances, emphasises the need for a series of trials to arrive at a definite recommendation for a particular species. On the basis of these trials it may not be unnatural to presume that the aforesaid firms should have based their recommendations on such trials.

The use of these substances in propagation is as yet a new technique and it is therefore premature to say which species respond better and which do not. The selection of the most suitable material, the age of the wood, the health of the parent plant, the care of the cuttings while in the rooting medium, and the precautions to minimise losses from diseases all remain as essential considerations for the best results.

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* A separate trial was under way (the details of which appear in another part of this series) where grape vine formed the material for an investigation on 'depth of planting cuttings'. These cuttings were planted without any pre-treatment. Rooting in these was found to be very little compared to the trial mentioned above.

From the data presented in this paper, one is inclined to agree with Pearse (1939) that with species which are easy to root without treatment, optimal treatment rarely fails to result in increased root formation, and that the shortening of the time required for root formation is a distinct gain in time with the added possibility of handling many more cuttings, during the season. Although a separate trial to observe the 'quickness' in rooting in particular could not be taken up, it was incidentally observed from comparison with a similar batch of untreated grapevine cuttings used for a different trial, that the rooting was definitely meager compared to the luxuriant production of roots in treated cuttings.

The fact that roots in untreated cuttings were long, fibrous and thin and those of the treated were shorter and thicker may raise the issue whether this feature of the thickness is desirable at all from the point of view of planting a vineyard. Considering the production of such a large mass of roots in a short time and the fact that the life of the cutting in a nursery bed is only a temporary phase and that the same condition of the roots need not persist in a well-manured orchard site, it can safely be said that the propagator need never feel concerned about the shortness or thickness of the roots in the nursery bed, especially as the cuttings are grown in an ill-nourished bed of sand.

With subjects difficult to root, however a response is not always easy to obtain and the use of hormones will not replace the careful attention to details necessary without their use.

For a proper utilisation of the growth hormones for rooting of cuttings a comprehensive study will be essential in order to determine the more optimal concentrations, the type of hormone, the method of application and its effect on different types of plants under the different phases of their development. This knowledge becomes all the more important because of the growing tendency to an indiscriminate use of hormones caused by spectacular results achieved with some plants. Intense work in this direction may be as important to the horticulturist as variety testing because of the large number of proprietary preparations released in the market.

Before undertaking such trials with these substances, other methods without the aid of any accessories, have also to be planned simultaneously. Certain findings of a fundamental nature may be lost sight of while attempts are being made to solve problems of a more complicated nature. An excellent illustration of this is provided by S. R. Varma, Director of Agriculture, Patiala, who in an article entitled "Glimpses of Fruit Culture in Ancient India", presents the 50th Chapter of "Vrikshayurveda" compiled or composed by Brahma Sangitacharya in 1449 Bikrami, on the importance of fruit culture. Dealing with methods of propagation, it is mentioned therein that jack is propagated

both by root cuttings and by root or stem grafting.* Although stem grafting of jack is fairly well-known now, propagation by root cuttings and root grafting have not been very promising or popular and it seems therefore worthwhile pursuing this aspect to be able to popularise this and such other methods of propagation.

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TABLE I.

Showing the number and weight of roots.

Cutting No.	Number of roots									
	Cattle urine 10%	Cattle urine	water	B-indol acetic acid	Sera-dix H	Potas-sium perman-ganate	2 : 4-D	Sera-dix B. (3)	B-indol butyric acid	Horto-mone A
1	31	...	28	13	15	10	...	52	6	47
2	25	...	13	6	17	8	...	37	29	32
3	21	...	29	13	34	8	...	68	30	63
4	42	...	5	24	29	9	...	47	22	30
5	33	...	30	11	35	22	2	11	22	39
6	29	...	8	14	26	9	...	36	28	43
7	31	...	26	16	13	13	5	18	29	43
8	30	...	11	21	39	25	...	13	17	41
9	25	...	20	19	28	15	...	26	16	38
10	25	...	26	18	20	17	7	2	24	81
Total ...	300	...	196	155	256	136	14	310	223	457
Total weight in gms.	2·15	...	1·30	1·70	2·24	1·38	0·02	1·60	2·10	2·93

Note :— As the roots were very tender and brittle and in some cases too few, weights of individual cuttings could not be recorded.

* The jack fruit, the Asok, the Kadali, the Jamun, the monkey fruit, the pomegranate the grape, Palivat and Muktaka are propagated by root cuttings or by root or stem grafting. Whichever method is adopted the cutting or grafting, a protective liquefied coat of dung must be applied.