SATURDAY MORNING SESSION
September 12, 1970

The Saturday morning session began at 10:35 a.m. in the Minnesota East Ballroom of the St. Paul Hilton Hotel. Ralph Shugert served as moderator. The minutes of the three Regions' business meetings which were held before the presentation of the technical papers appears at the beginning of the "Business and Technical Sessions."

RALPH SHUGERT: This Twentieth Annual Meeting has certainly been an enjoyable session and, as announced previously, we have the Graduate Student Award winner with us and he will present his winning paper to us this morning. The winner, as you know, is Mr. Nazir Nahwali and the title of his paper is "The Effect of Dipping Depth and Duration of Auxin Treatment on the Rooting of Cuttings." Mr. Nahwali.

THE EFFECT OF DIPPING DEPTH AND DURATION OF AUXIN TREATMENT ON THE ROOTING OF CUTTINGS

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ABSTRACT

Factors hitherto not taken into account were shown to influence the rooting response of hardwood plum cuttings to treatment with IBA in 50% alcohol. The depth to which cuttings were dipped in the auxin solution and the duration of the dipping treatment were important, while rooting in cuttings dipped to 1 inch was improved by wounding.

REVIEW OF LITERATURE

Pre-treatment of cuttings with a root promoting substance is a singularly effective method of obtaining rooting in cuttings of many plants. Active substances and methods for their application, together with the responses of a wide range of plants, have been well documented (1, 2, 6).

Auxins are applied to cuttings either in a powder formulation, as a dilute aqueous solution requiring cutting treatment for up to 24 hours, or in solvents such as alcohol (8) in which the cuttings are dipped for a brief period of a few seconds (4). This "quick dip" method is favoured for hardwood cuttings because of the speed and uniformity of

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treatment (5). However, a number of factors which may contribute to treatment success have apparently been ignored. For example, authors often state that "cuttings were dipped to a depth of half to one inch", or treated "for a few seconds," suggesting that neither depth nor duration of dipping is considered critical.

From a study of rooting in plum hardwood cuttings it has become clear that insufficient attention has been given in the past to these and other conditions of auxin treatment. The influence of a number of factors upon cutting response to indolylbutyric acid (IBA) has been examined and the results of some of these experiments are given below.

MATERIALS AND METHODS

Vigorous annual shoots were collected from hard-pruned hedges of five plum rootstocks during autumn or spring 1968, 1969, and 1970, and reduced to 24-inch lengths to provide basal (proximal) cuttings (3).

They were treated with IBA dissolved in 50% ethanol in the manner stated in the appropriate experiment. After drying for about 30 minutes cuttings were placed in a rooting compost of equal parts coarse sphagnum peat (pH 3.9) and 3/16-inch grit with washed sand (pH 7.1), with a basal temperature of approximately 20° C (7). The aerial environment was not controlled, although extremes of weather were reduced by the open-sided building which housed the propagation bins. Percentage rooting (subsequently transformed to angular values) and number and position of roots were recorded after a period of usually four weeks. Least significant differences at the 5% level are shown at the top left-hand corner of the figures.

RESULTS AND DISCUSSION

Fig. 1 shows the response of four plum clones when treated to a depth of one inch for five seconds with a concentration range of IBA from 500 to 10,000 ppm. It is of interest in that it shows a fall-off in rooting at the highest IBA concentration. This was associated with the general absence of roots emerging from the basal 0.5 cm portion of the cutting, which suggested that this concentration was supra-optimal in tissues adjacent to the point of IBA entry. The possibility that further improved rooting could be obtained by applying a greater quantity of IBA to the cutting at a lower concentration was therefore examined by dipping to a greater depth.

Results are shown in Fig. 2 for 'Myrobalan B' cuttings dipped for 5 seconds at depths ranging from 0 (basal cut surface wetted) to 4 inches. An exponential response curve was unexpectedly obtained where percentage rooting rapidly decreased with increasing dipping depth ($P = 0.001$). Two other rootstocks showed a similar but non-significant trend.

The main difference between basal application and greater dipping depth is that almost no IBA is applied to the side of the cutting when only the basal cut surface is treated, compared with varying amounts of side application at greater depths. The importance of position of IBA application to the cutting was therefore examined. A 5 second application to only the basal cut surface was compared with application to the proximal 1 inch of the epidermis, together with the normal 1 inch dip to include both base and side.

Two methods were used to treat specific parts of the cuttings in this way. Areas not to be treated were sealed with a polyvinyl resin, which was subsequently removed where necessary to allow uptake of water, or the growth substance was applied by a small brush; similar results were obtained by both methods.

Fig. 3 shows that with 'Myrobalan B' and 'E 340 / 8.21' (a rootstock at present under test) inferior rooting was obtained ($P = 0.001$) when the side only was treated compared with a high rooting percentage when IBA was applied to the basal cut surface only. The traditional base and side treatment fell between these two extremes. These and later results suggest antagonism between base -and side- applied IBA. The effect due to position of IBA application increased with increasing concentration of the auxin ($P = 0.001$) as shown in Fig. 4.

Since the original optimum IBA concentration for plum cuttings was determined by dipping cuttings to a depth of 1 inch (Fig. 1), and with basal application subsequently shown to be more effective (Fig. 2), it was necessary to re-determine the concentration response with shallow dipping.

Cuttings of 'Myrobalan B' were treated either at the basal cut surface or for the basal 1 inch at a range of concentrations from 0 to 10,000 ppm. To integrate earlier experiments which suggested that the detrimental effect of deeper dipping was from side application, in a subsidiary study cuttings were also treated at their base with 5,000 ppm and for the adjacent 1 inch of epidermis with IBA ranging from 0 to 5,000. Thus, a range of treatments was produced linking with those of the main experiment in which 5,000 ppm IBA was applied to either the basal cut surface or 1 inch stem. Fig. 5 shows that shallow dipping was superior to dipping for 1 inch and that the optimum concentration was reduced from 5,000 to 2,500 ppm in the absence of side application.

The effect of increasing the concentration of side-applied IBA from 0 to 5,000 ppm was to gradually depress rooting from a level almost equivalent to that obtained by shallow dipping at 5,000 ppm, to one inferior to that obtained after dipping to 1 inch.

In contrasting basal IBA application with treatment to the epidermis, it was apparent that uptake was relatively rapid through the basal cut surface and either absent or impeded through the side of the cutting. The effect of possibly increasing uptake by wounding the side of the cutting was, therefore, examined with 'Myrobalan B'.

Two to three small scooping wounds to remove either the buds or equivalent internode tissue to the depth of the xylem were made over the basal 1 inch of the cuttings, which were then dipped to that depth in 5,000 ppm IBA. Cuttings that had internode wounds gave a higher response (Fig. 6) than those which had bud wounds, which in turn were superior to the control ($P = 0.001$). Roots arose from the cutting base and the wounds. A similar trend was obtained for a second clone which is not shown.

Another factor likely to influence IBA uptake and response of cuttings to auxin concentration is the duration of treatment.

'Myrobalan B' cuttings were treated for periods from 1 second to 18 minutes at 50, 500, and 5,000 ppm. A dipping depth of 1 inch was chosen to offset possible problems of changes in the solution level at shallow depth over the longer dipping times and also to depress the general response in order to detect treatment differences. Fig. 7 shows a correlation ($P = 0.001$) between duration and concentration, with the higher concentration most effective at 5 seconds, the medium at 30 seconds, and the lowest concentration requiring an 18 minute period of uptake. In relation to the "quick dip" method, the different response at 1 and 5 seconds is of particular interest.

Throughout these experiments consistent trends were obtained for the effect of treatments on the number of roots produced. Although differences were often significant they were not sufficiently large to affect the establishment of the cuttings. Generally, root production increased with increasing concentration of IBA and with wounding, but decreased slightly with decreasing dipping depth. Within the proximal inch, however, treatment to only the basal cut surface was superior.

These results are important in the development of methods for the practical application of auxin treatments and may have wide application in the propagation of plants by cuttings.

It is also hoped that the demonstration of the need for effective IBA uptake through either the cutting base or a wound, and the apparent antagonism of laterally applied IBA will lead to a clearer understanding of the mechanism of auxin stimulation of rooting in cuttings.

ACKNOWLEDGEMENT

This work is part of a study for the Ph.D. degree carried out at East Malling Research Station, Kent, England. The assistance of members of the Pomology Section and, in particular, the encouragement and advice of my superior, Dr. B. H. Howard, is gratefully acknowledged.

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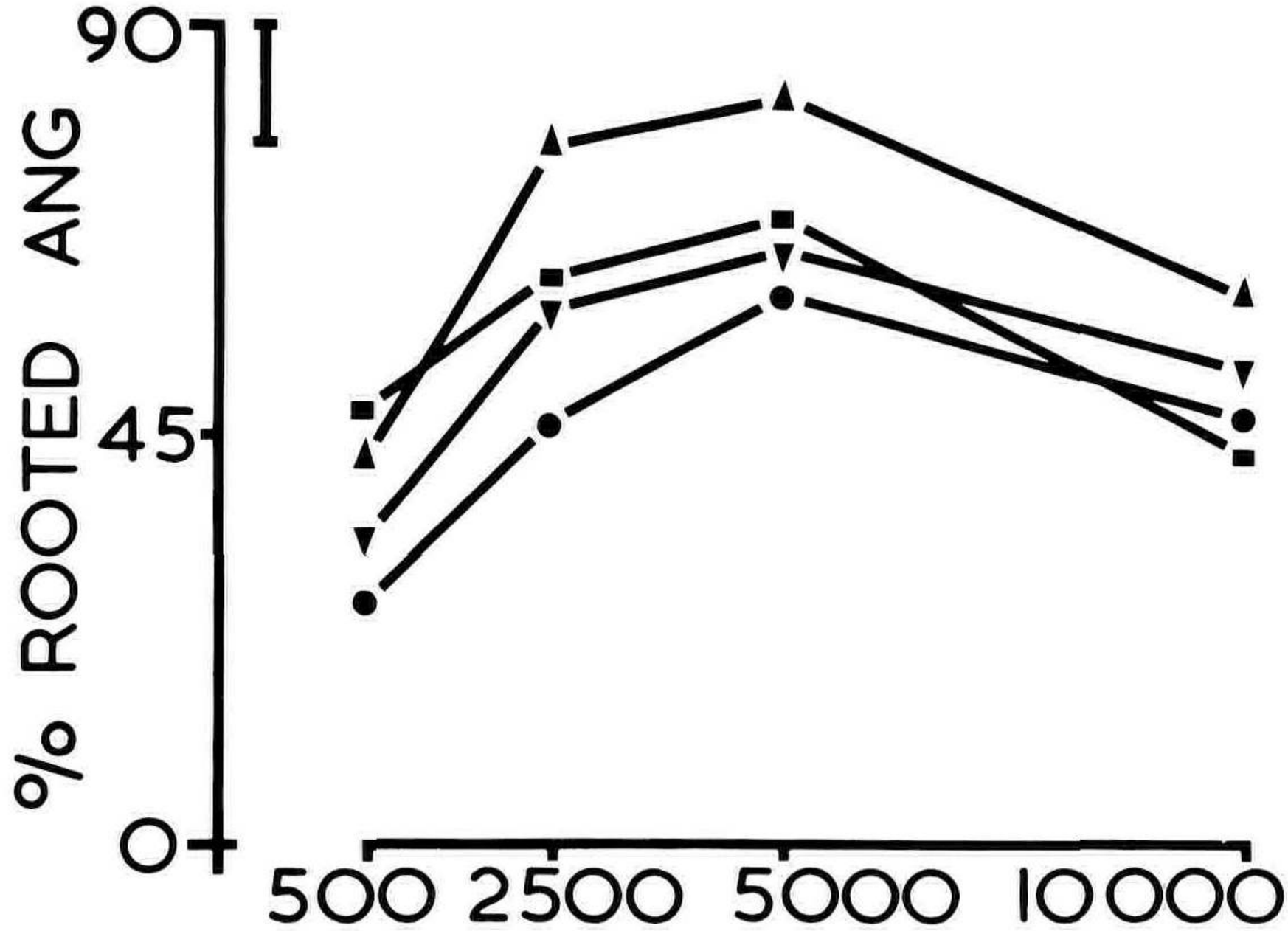

Fig 1. Response of four rootstocks to IBA concentration

- ▲ 'Myrobalan B' *(P. cerasifera)*
- ■ 'St. Julien A' *(P. insititia)*
- ▼ 'EA 16' ('Pershore' x 'Brussels'; *P. domestica*)
- ● 'Brompton' *(P. domestica)*

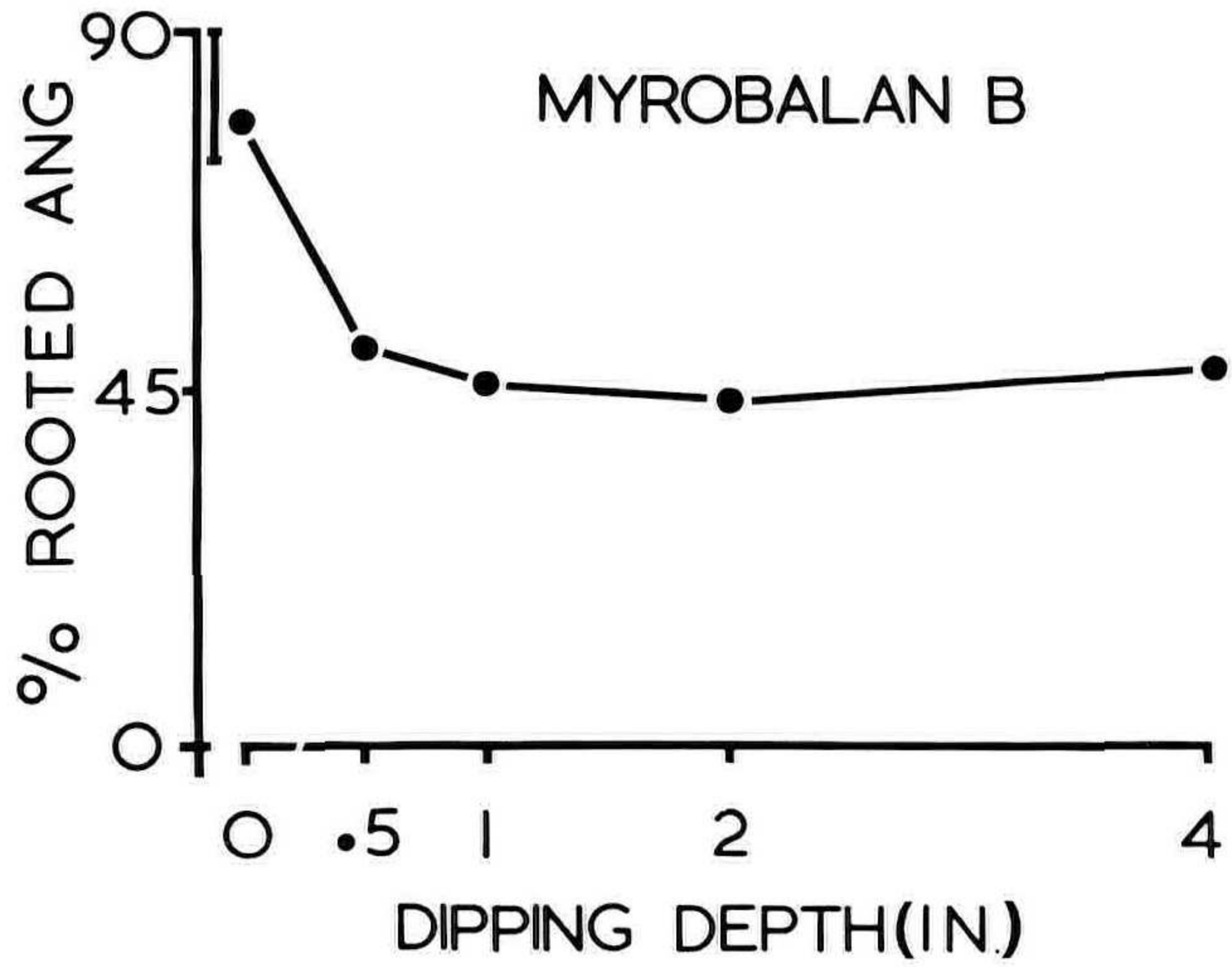

Fig. 2. Rooting related to IBA dipping depth.

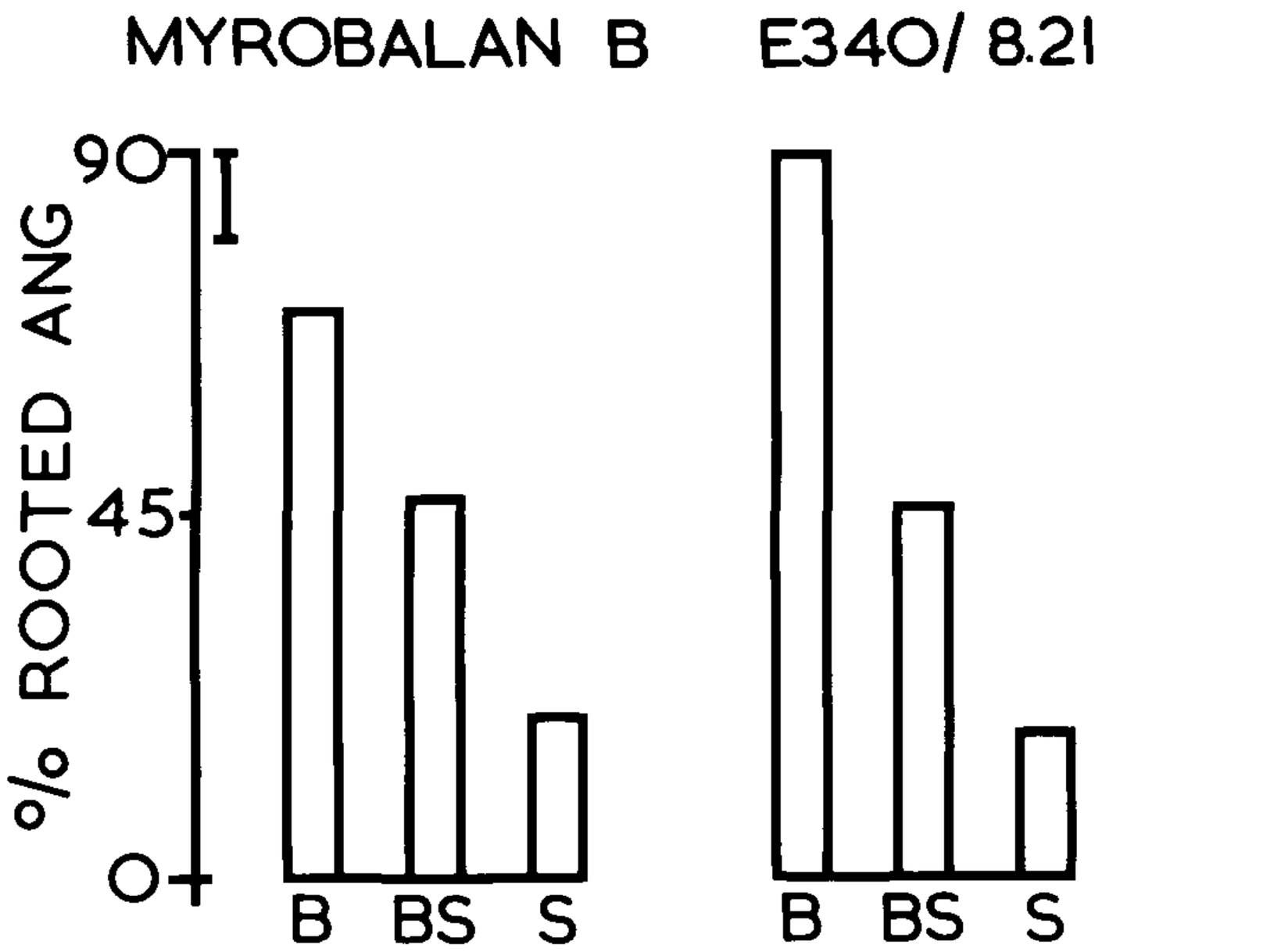

Fig. 3. Rooting of two clones related to position of IBA application.

B = Basal application
BS = Base and side application (1 inch dippıng depth)
S = Side application for 1 inch

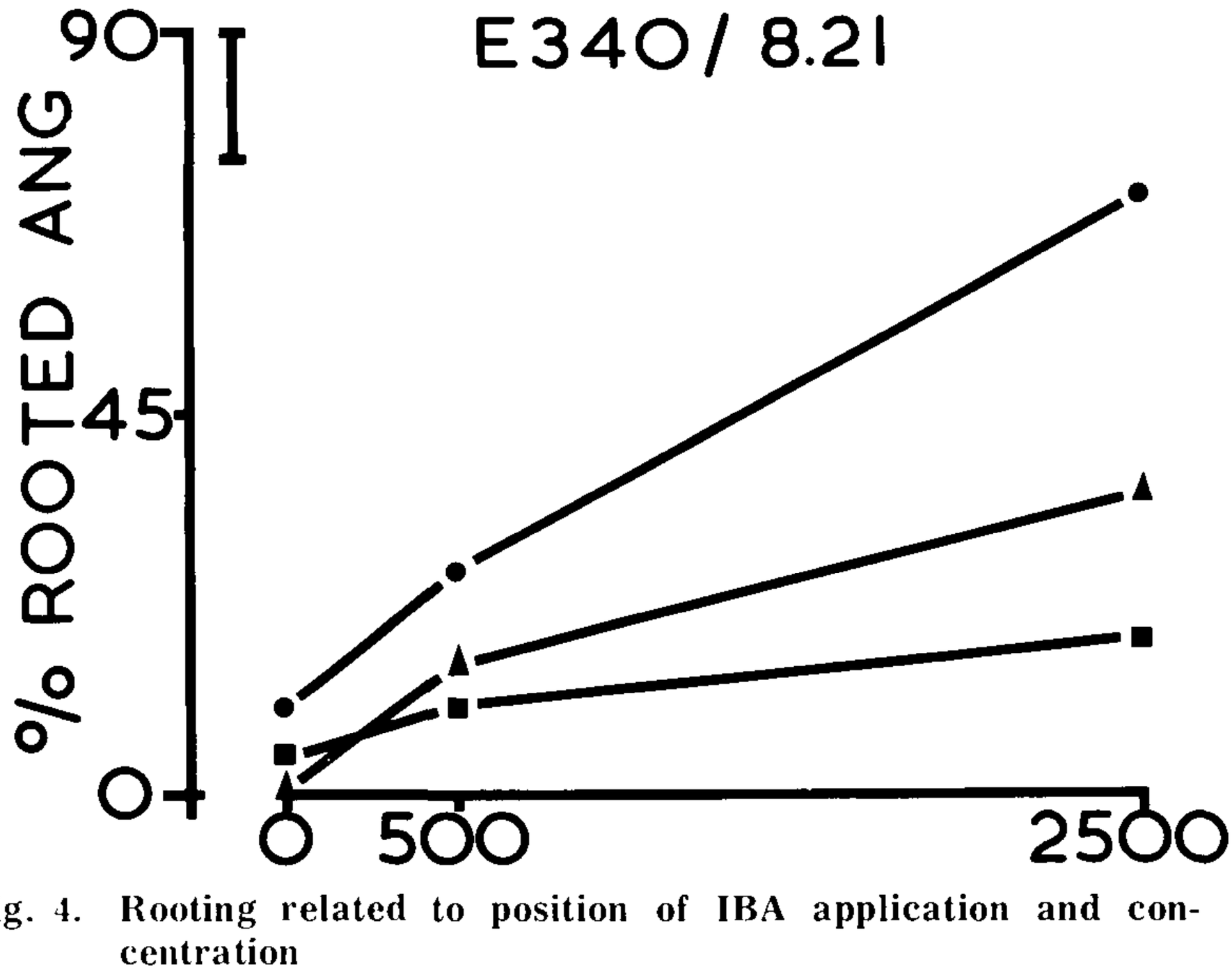

Fig. 4. Rooting related to position of IBA application and concentration

● Basal application
▲ Base and side application (1 inch dipping depth)
■ Side application for 1 inch

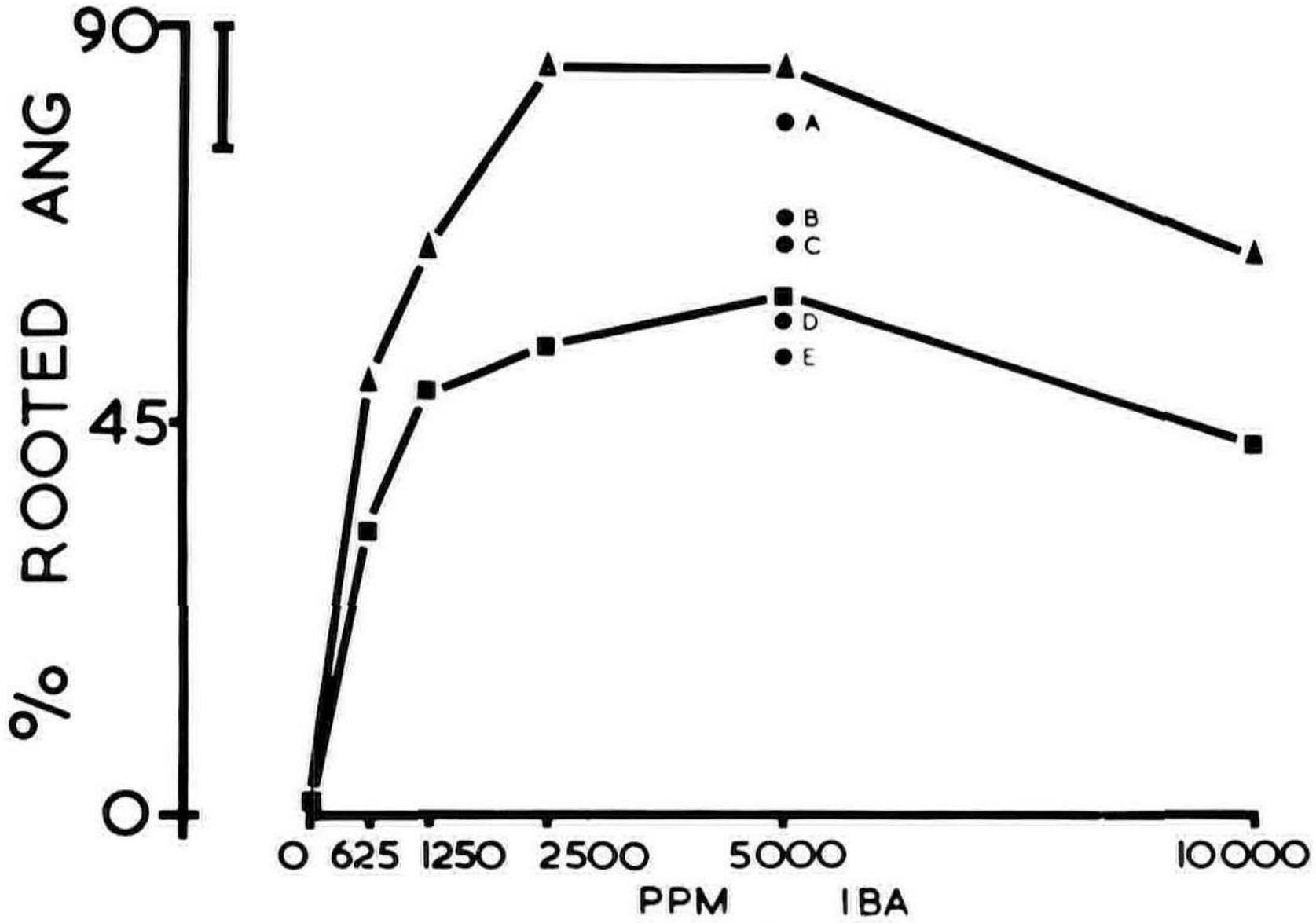

Fig. 5. Response of 'Myrobalan B' cuttings when treated with IBA at different depths and concentrations.

▲ Basal IBA application

■ One-inch dipping depth

A to E, 5,000 ppm basal application with 1 inch side applied IBA at 0, 625, 1,250, 2,500 and 5,000 ppm respectively

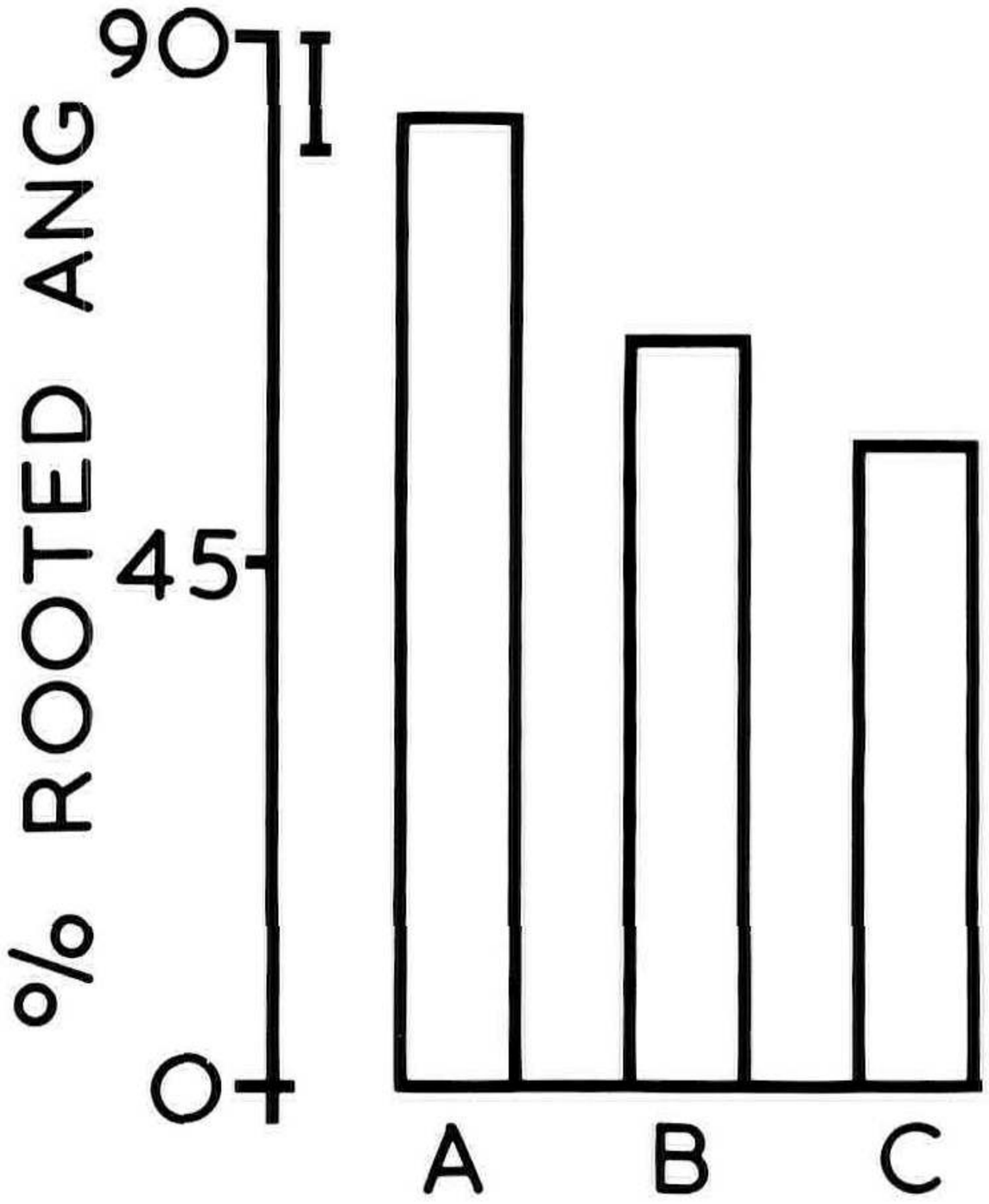

Fig. 6. The effect of wounding upon 'Myrobalan B' cuttings dipped to 1 inch at 5,000 ppm IBA

A Two to three internode wounds

B Two to three buds removed

C Normal control

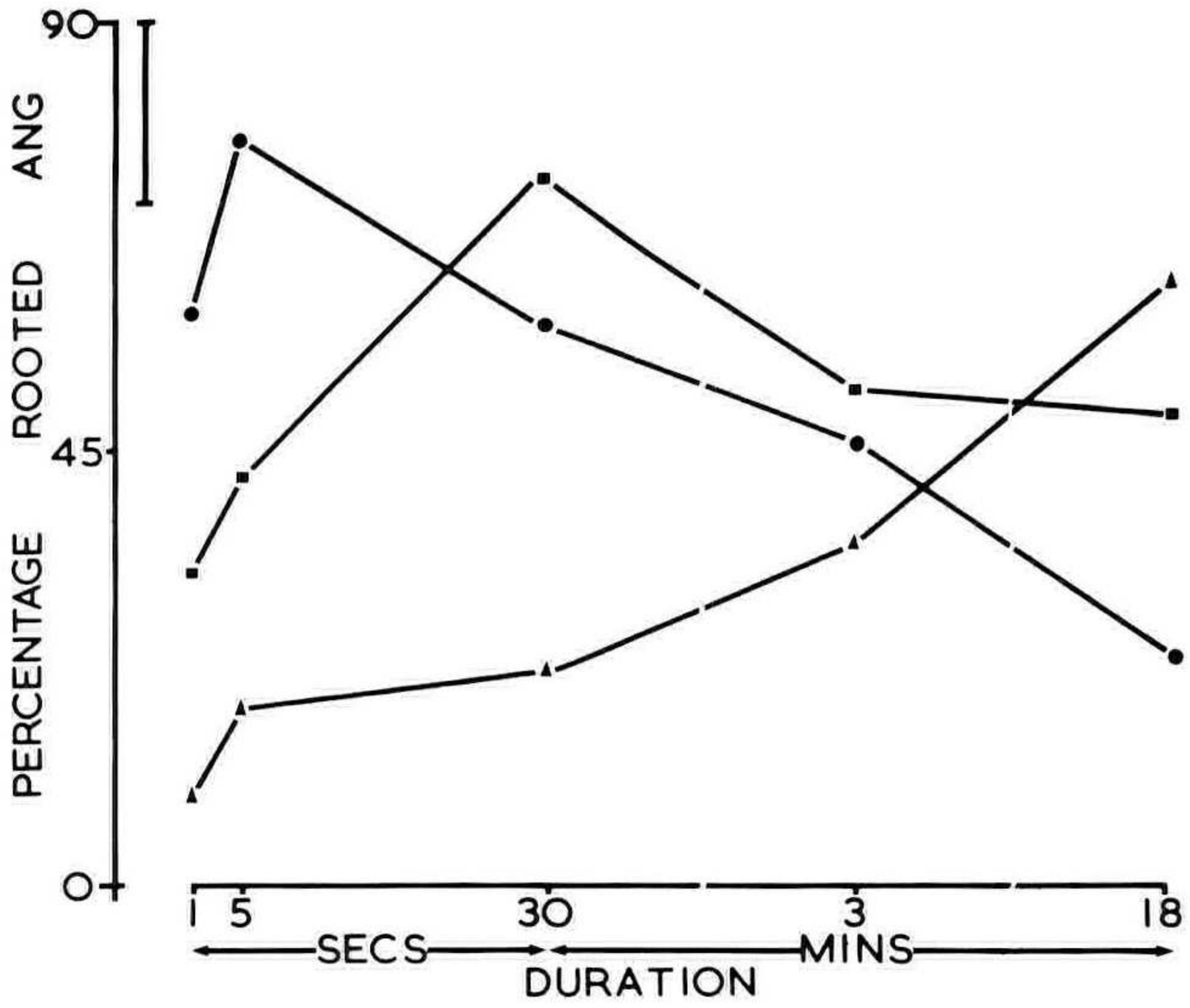

Fig. 7. Relationship between duration of IBA treatment and concentration for 'Myrobalan B'

- ● 5,000 ppm IBA
- ■ 500 ppm IBA
- ▲ 50 ppm IBA

RALPH SHUGERT: That is certainly a marvelous piece of work; thank you very much for presenting it to us.

The next speaker is a gentleman that I have known for several years; this past July I visited his nursery and found that everything I had heard about it was true. It is certainly a well-run operation — much advanced in techniques. The title of his paper is "Plant Propagation and Systems Analysis" in which he will summate some of his ideas and philosophies of a successful nursery operation. It is with a great deal of honor I present to you George Oki.