Our next speaker is certainly no stranger to us in the Eastern Region and he has made considerable contributions to the area of plant propagation and the growing of nursery plants. Dr. Sidney Waxman will discuss the effect of flowering on survival of 'Cornell Pink' rhododendron cuttings.

EFFECT OF FLOWERING ON SURVIVAL OF *RHODODENDRON MUCRONULATUM* 'CORNELL PINK'

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Abstract. With most woody species, problems in propagating by cuttings lie in their ability to initiate roots. For some ornamental and forest species, however, the problem is that they have an extremely high rate of mortality after root initiation.

Mortality of rooted 'Cornell Pink' rhododendron cuttings is associated with anthesis. The greater the numbers of flowers blossoming on the cuttings, the greater the losses. Removal of the flower buds, at any time before blossoming, will enhance survival.

Cuttings taken early in the season had the lowest number of flower buds and, as a consequence, had the highest rate of survival. Eight-hour photoperiodic treatments inhibited flower bud initiation.

REVIEW OF LITERATURE

It is well known by propagators that when taking cuttings, one should avoid taking those having flower buds. The reason for this is that flower buds often have a depressing effect on root initiation (1, 5, 7).

For some species, especially those easy to root, the presence of flower buds does not appear to be a serious deterrent to rooting, while with other species, e. g. blueberry, the presence of flowers can

mean the difference between success or failure (5, 6). With rhododendron the removal of the flower bud will greatly improve rooting over cuttings whose buds are not removed (1,2) while with blueberry, the initiation of a flower bud will be detrimental regardless as to whether it's removed or left intact (5,6).

The results of these experiments illustrate a somewhat different effect of flowering. In this instance, flowering does not affect rooting but it does determine whether the rooted cutting lives or dies.

The problem of overwintering rooted cuttings has been a serious one for a group of woody plants including: *Cornus florida, Acer saccharum, Acer palmatum,* certain species of rhododendron, and viburnum. Although most of these species can be propagated quite easily, they suffer high rates of mortality after rooting. For some species that are highly susceptible to winter injury, these problems can be solved by placing the dormant cuttings in heated coldframes or in cool greenhouses to protect them from freezing (3).

Another method of overcoming this problem is by the use of photo-periodic treatment. It has often been reported, especially for the deciduous azaleas, that survival can be assured by first encouraging new branch growth immediately after the cuttings have rooted and then overwintering them. This may be accomplished by subjecting them to long photoperiods (4, 8, 9, 10). Such treatment has proven to be most effective on cuttings taken early in the season from greenhouse-forced plants and then exposed to 16-24 hours of light daily.

The 'Cornell Pink' was used in this test because it fits within the category of plants that are difficult to propagate because they usually have low levels of survival after having been rooted.

The 'Cornell Pink' initiates roots easily; percentages between 80 and 100 are normally obtained. One of the problems of this plant is that its cuttings have the tendency to split while being overwintered. Splitting usually occurs during the first hard freeze.

One way to overwinter 'Cornell Pink' successfully is to illuminate it with incandescent light for 6 to 10 hr each night. Within approximately 5 weeks, the buds will become active and new shoots will be formed. Once the cuttings are forced into new growth, they may be handled in two ways: They may either be kept actively growing (under long photoperiods) throughout the entire winter and early spring; or they may be gradually hardened in late fall by turning out the lights and then overwintered in a heated frame or greenhouse where temperatures in the range of 35° to 45° F can be maintained. Although both of these methods have brought about a generally high rate of survival, they require a long period of time in the greenhouse and are, consequently, costly.

Another method of carrying them through the winter is to harden them off after rooting and overwinter them in a frame or greenhouse held at temperatures between 35° to 45° F. This method does not require the application of supplemental light and no additional leaf or stem tissue is produced. Cuttings handled this way survive the winter in excellent condition. However, periodic inspections of the cuttings in the heated frame found them living and healthy during January and February; flowering in March, but mostly dead by late April.

'Cornell Pink' normally develops foliage after flowering has taken place. In this test, however, the leaf buds did not expand and produce leaves, but remained dormant. With time the cuttings weakened and, as their food reserves dwindled, they died.

An experiment was carried out to determine the relationship between flowering and mortality, and incidental to this, to determine if the photoperiod and/or date the cuttings are taken has an influence on flower-bud initiation.

MATERIAL AND METHODS

On five different dates, 270 terminal cuttings taken from large field-grown 'Cornell Pink' rhododendrons were treated with Hormodin No. 3 plus Captan, and placed into three flats containing a 1:1 mixture of peat moss and perlite. Each flat containing 90 cuttings, was placed under a mist system and subjected to a long, short, or normal photoperiod. The normal-day group received normal daylight whereas the short-day and long-day groups received, each day, sunlight for 8 hr and were then shielded from the sun with a black cloth for the remaining 16 hr. During the 16 hr period, the long-day group was illuminated with low intensity incandescent light to extend the daylength to 24 hr.

The cuttings within each flat were divided into three groups. In the first group, the apical portions (where the flower buds originate) were pinched off on the day the cuttings were taken. In the second group, the apices were pinched on January 30th. At this time, all flower buds were fully developed but dormant. The flower buds of the third group were left intact and were permitted to blossom.

The percentage rooting was determined 90 days after each group of cuttings was taken. The percentage survival, based on the number of rooted cuttings, was determined several weeks after blossoming.

RESULTS

Rooting. In all daylengths combined, rooting percentages were somewhat higher on the cuttings that were initially pinched than those whose flower buds were left intact. Eighty-four percent rooting occurred on the pinched cuttings and 77% on the cuttings that were not pinched. The presence of flower buds is, apparently, not as

detrimental to the rooting of *Rhododendron mucronulatum* cuttings as it is to the rooting of those other species (5, 6, 7).

Flowering and survival. The data presented in Figs. 1, 2, 3, 4 are representative of the groups of cuttings whose flower buds, where present, were left intact and permitted to blossom. The percentage survival was highest for those cuttings taken June 19 regardless of which photoperiodic treatment they were subjected to (Fig. 1). Survival of cuttings which were taken only 1 week later dropped to 36% (long-days) and to 35% (normal-days), while those exposed to short-days remained at a high level of 84%. For each succeeding date the percent survival decreased in the long-day and normal-day groups but remained high (except for the last date) in the short-day group (Fig. 1).

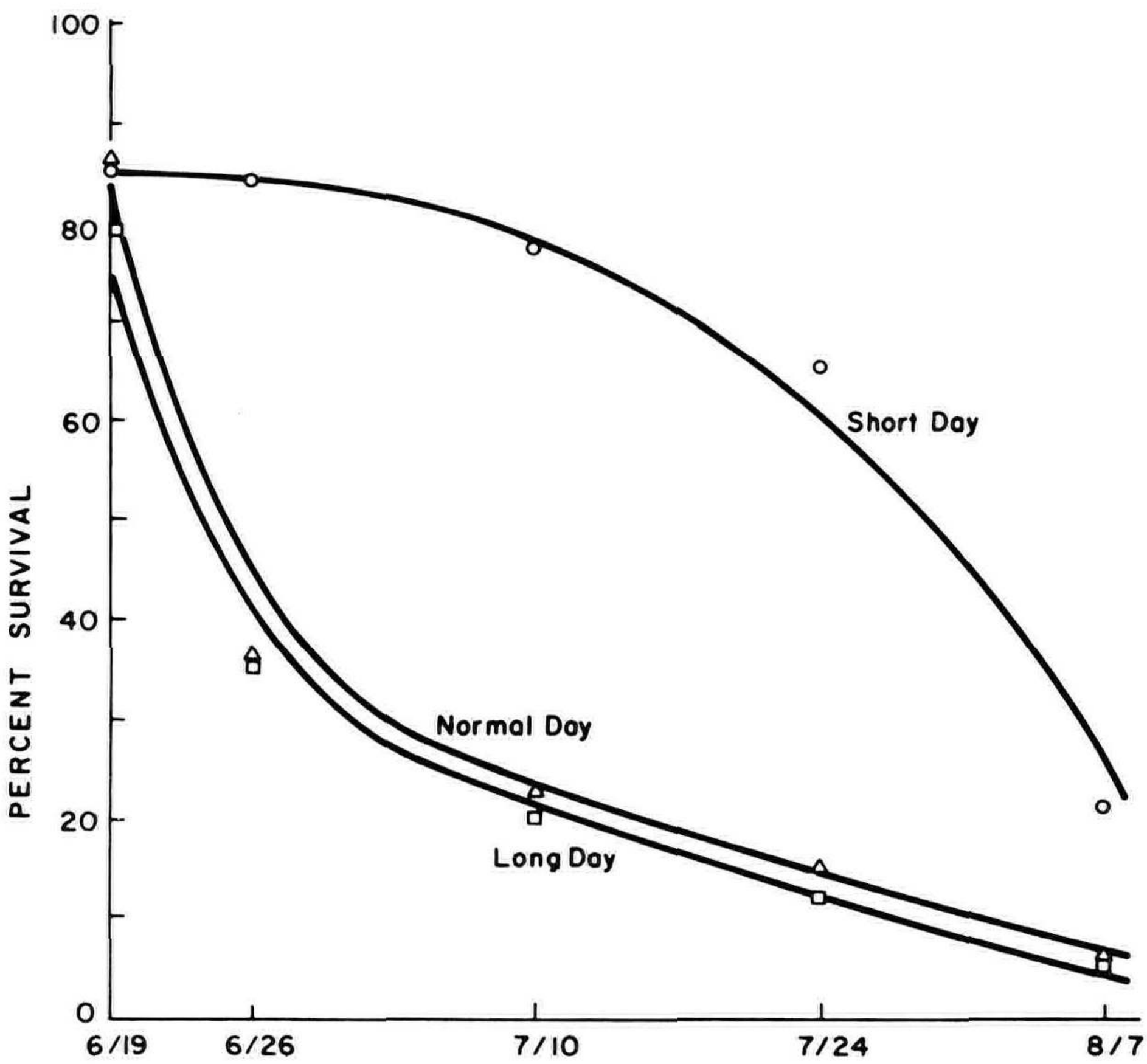

Fig. 1. The influence of date the cuttings were taken and daylength during the rooting period on survival of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink'.

Figures 2, 3, and 4 illustrate the extent of flower-bud development as a function of both date and photoperiod, as well as the percentage survival of rooted cuttings relative to the quantity of flower buds present. The number of flower buds initiated was lowest on the earliest date the cuttings were taken. With each succeeding date the average number increased to a maximum of approximately four flower buds per cutting.

Fewer flower buds were initiated in the short-day treatment than in either the long or normal-day treatments. This response was most pronounced in those groups taken on the first three dates (Figs. 2, 3, 4).

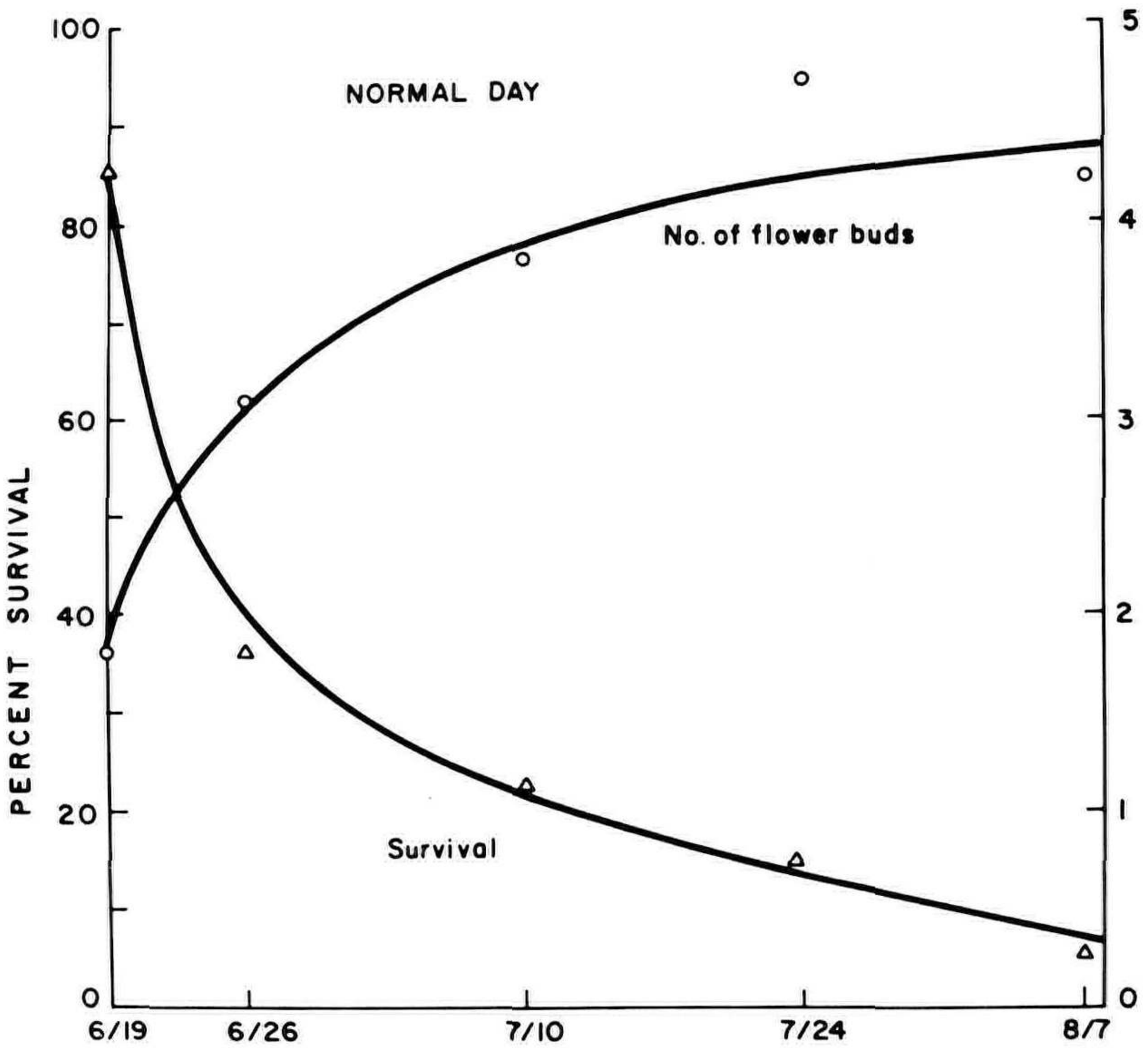

Fig. 2. The relationship between flowering and survival of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink'. The cuttings were subjected to normal photoperiods during root initiation.

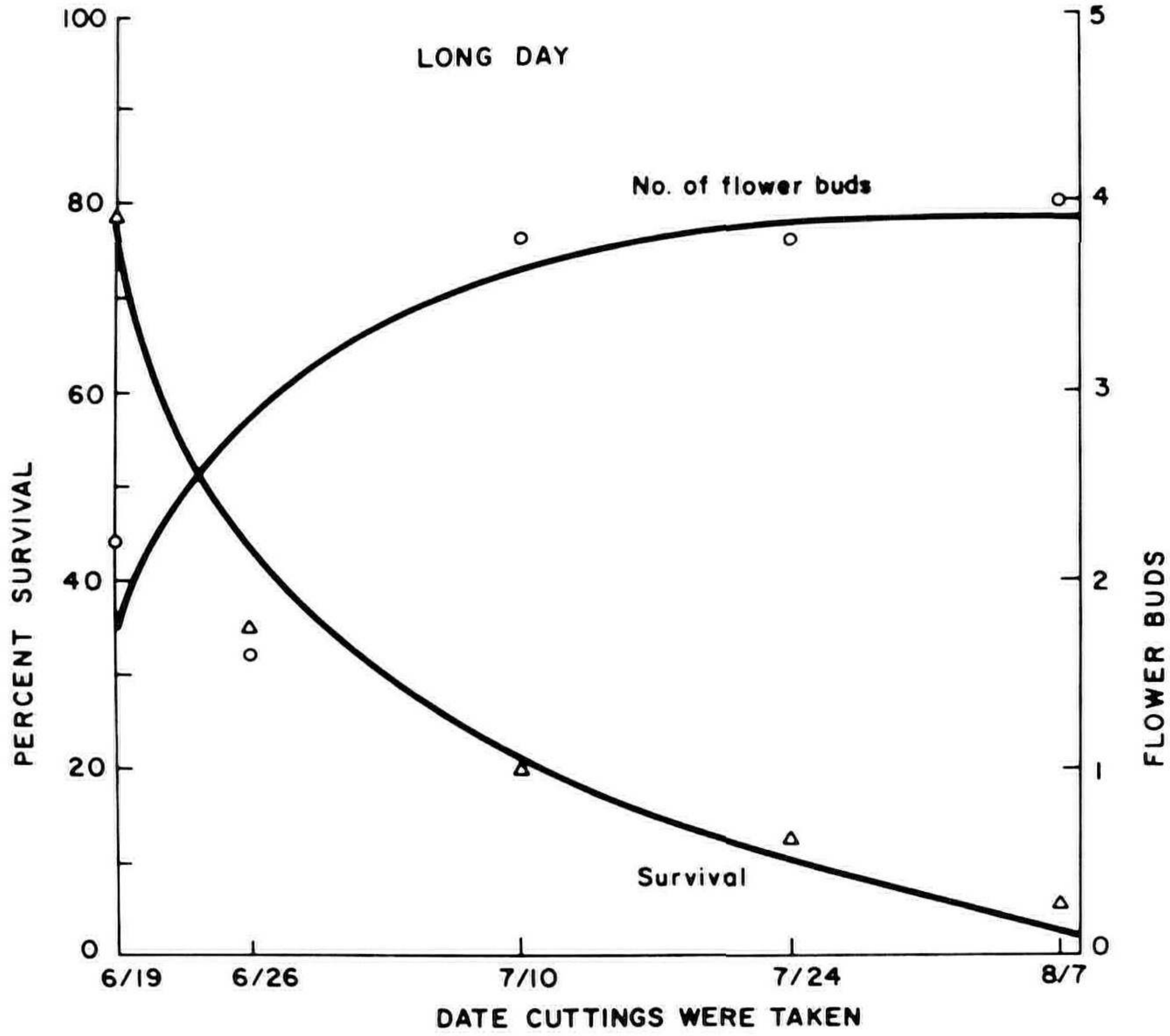

Fig. 3. The relationship between flowering and survival of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink'. The cuttings were subjected to long photoperiods during root initiation.

Survival was negatively correlated with flowering. With the increase in the number of flower buds per cutting, there was a corresponding decrease in the percent surviving.

Removal of flower buds resulted in an increase in the percentage surviving over those cuttings whose flower buds were left intact and permitted to bloom (Figs. 5, 6, 7).

DISCUSSION

Survival of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink' is apparently contingent upon the number of flowers that develop on them. With the increase in the number of flowers blossoming, there is a decrease in the chances for survival.

The normal sequence of growth of 'Cornell Pink' as it emerges from dormancy is to blossom first and then develop shoots and

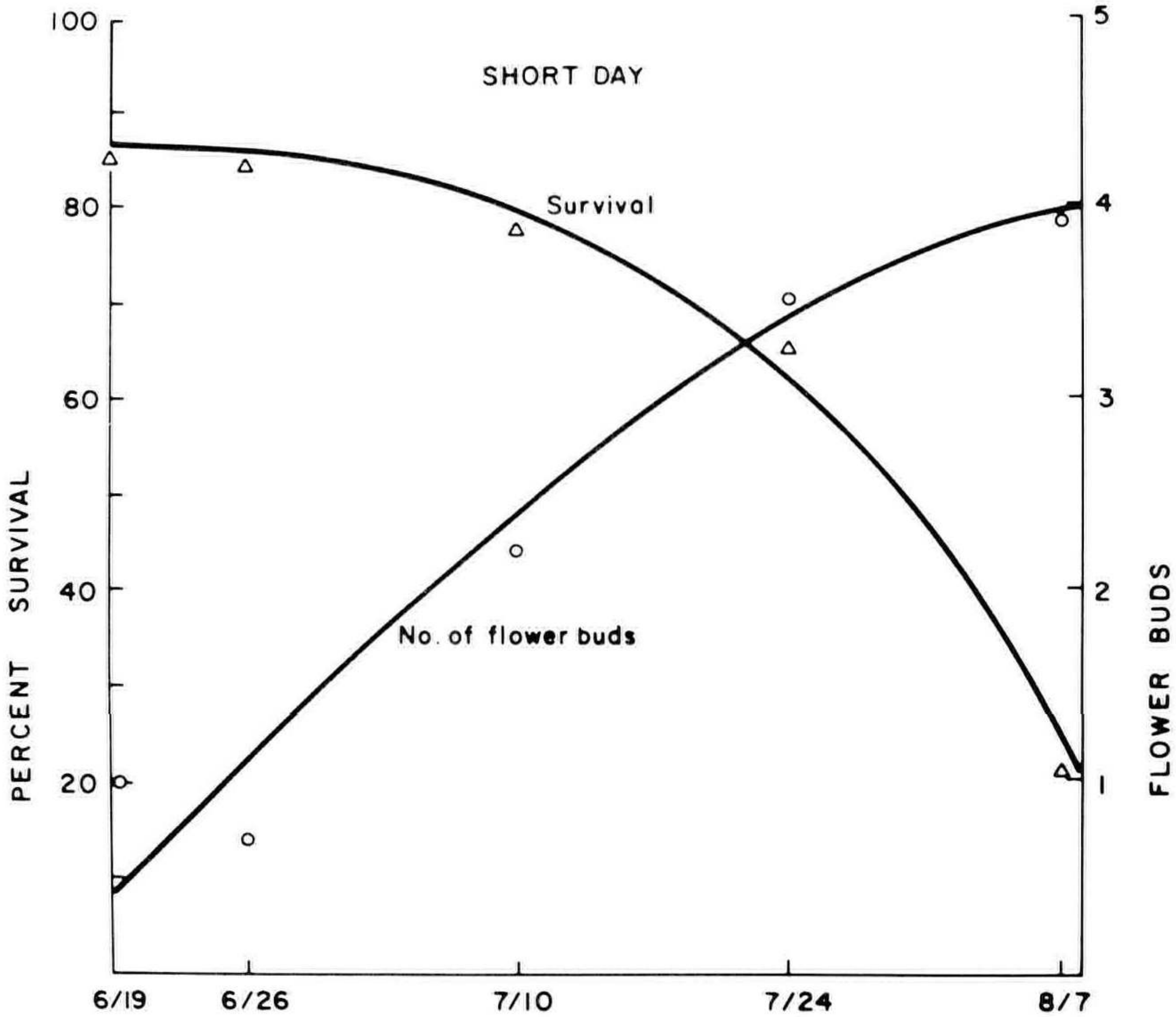

Fig. 4. The relationship between flowering and survival of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink'. The cuttings were subjected to short photoperiods during root initiation.

leaves. With rooted cuttings, only blossoming takes place; the vegetative buds remain dormant or, if able to expand, produce weak tissue which soon collapses. As a consequence, the cuttings, lacking foliage, are deprived of a source of energy that photosynthesis would have provided and subsequently die.

The threshold number of flower buds that determines whether or not the cutting will survive is three. The overall survival of those groups having an average of three or more flower buds per cutting was 25%, while those having less than three had 73% survival.

The first group of cuttings taken June 19 had the lowest number of flower buds and a high level of survival. With each succeeding date the cuttings were taken, the number of flower buds that developed on them increased and their chances for survival decreased.

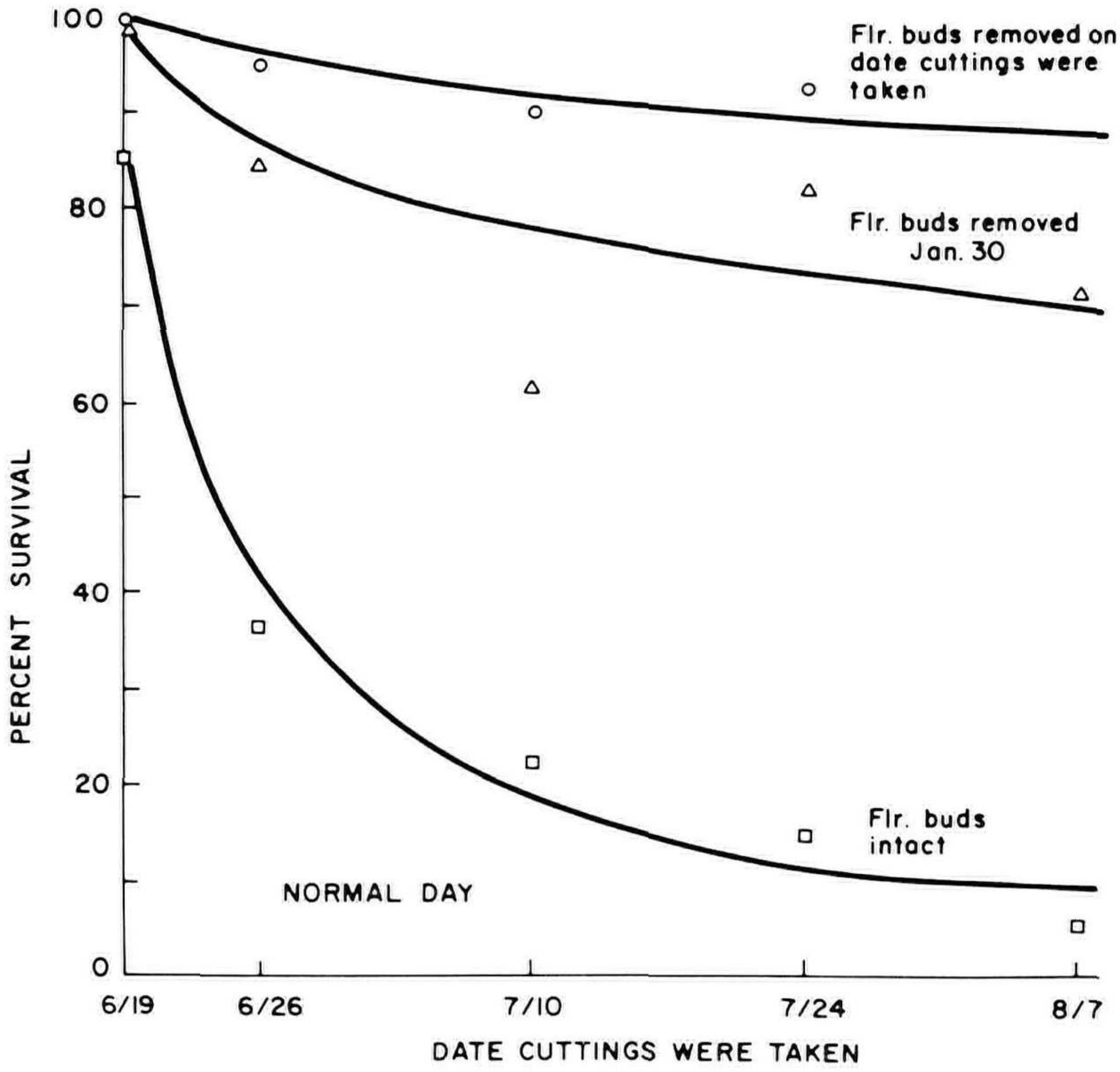

Fig. 5 The effect of the removal of flower buds on the survival of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink'. The cuttings were subjected to normal photoperiods during root initiation.

'Cornell Pink' rhododendron is apparently a "long day plant" insofar as its requirement for flower-bud development is concerned.

Exposure to short photoperiods apparently inhibited flower-bud development during its early stages. Exposure to long or normal photoperiods resulted in cuttings having twice as many buds as the short day-treated cuttings. The flower buds on cuttings taken as late as July 24 and August 7 were already well developed and were not influenced by short photoperiods.

Prevention of blossoming by the removal of the flower buds resulted in a high level of survival regardless of the photoperiodic treatment. This response substantiates the concept that the high levels of mortality that occur among rooted cuttings of 'Cornell Pink' rhododendrons are associated with flowering.

Elimination of the flower buds before flowering is equivalent to

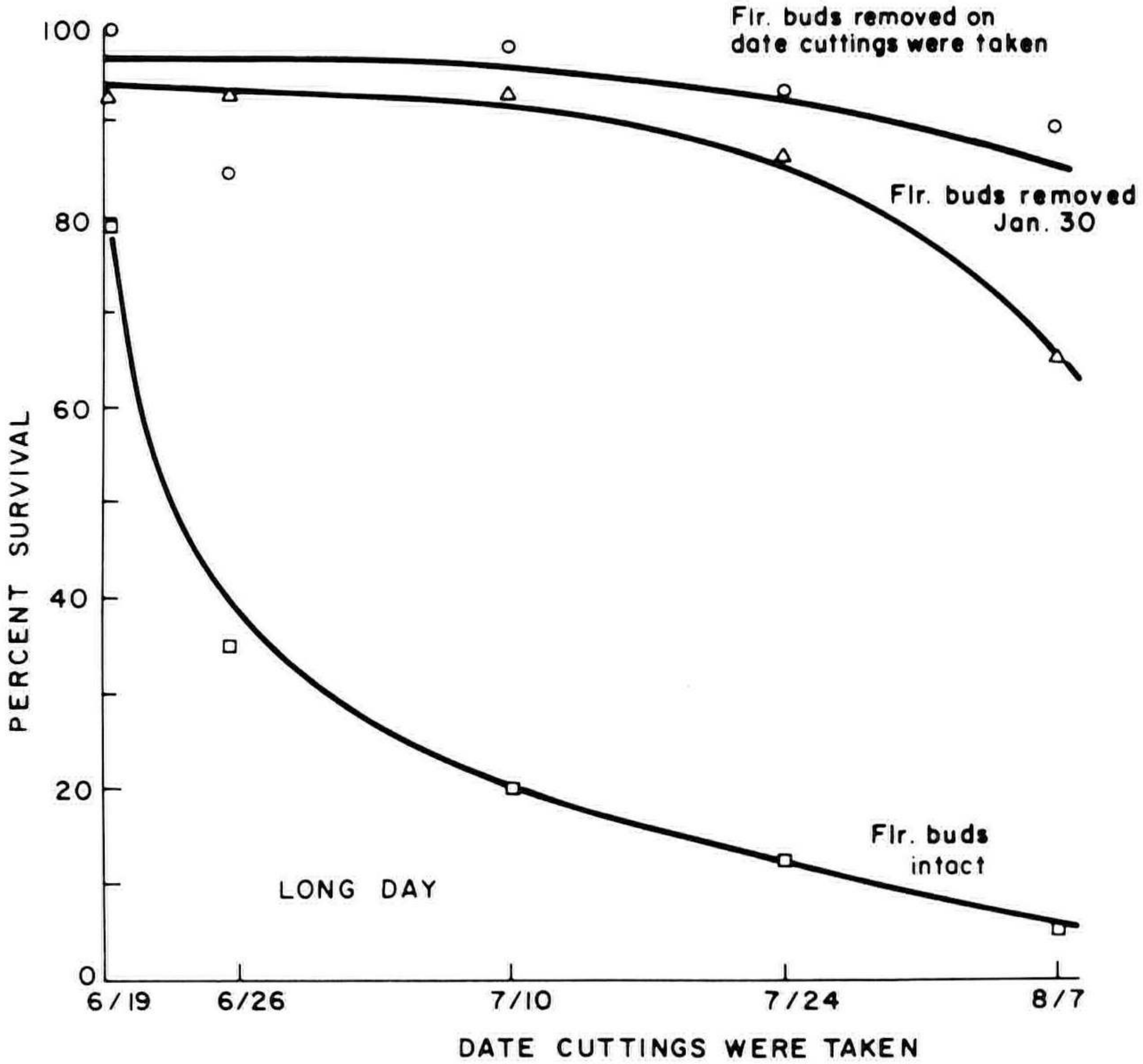

Fig. 6 The effect of the removal of flower buds on the survival of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink'. The cuttings were subjected to long photoperiods during root initiation.

the elimination of the factor(s) that prevent vegetative bud expansion and growth.

The factor(s) appears to be quantitative with a minimum of three flowers preventing leaf-bud growth.

CONCLUSIONS

The generally low survival rate of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink' is associated with flowering.

The factor(s) associated with blossoming is quantitive.

Vegetative bud expansion and leaf growth is unable to take place if three or more flower buds are permitted to blossom.

Flower bud development appears to have a long-day requirement.

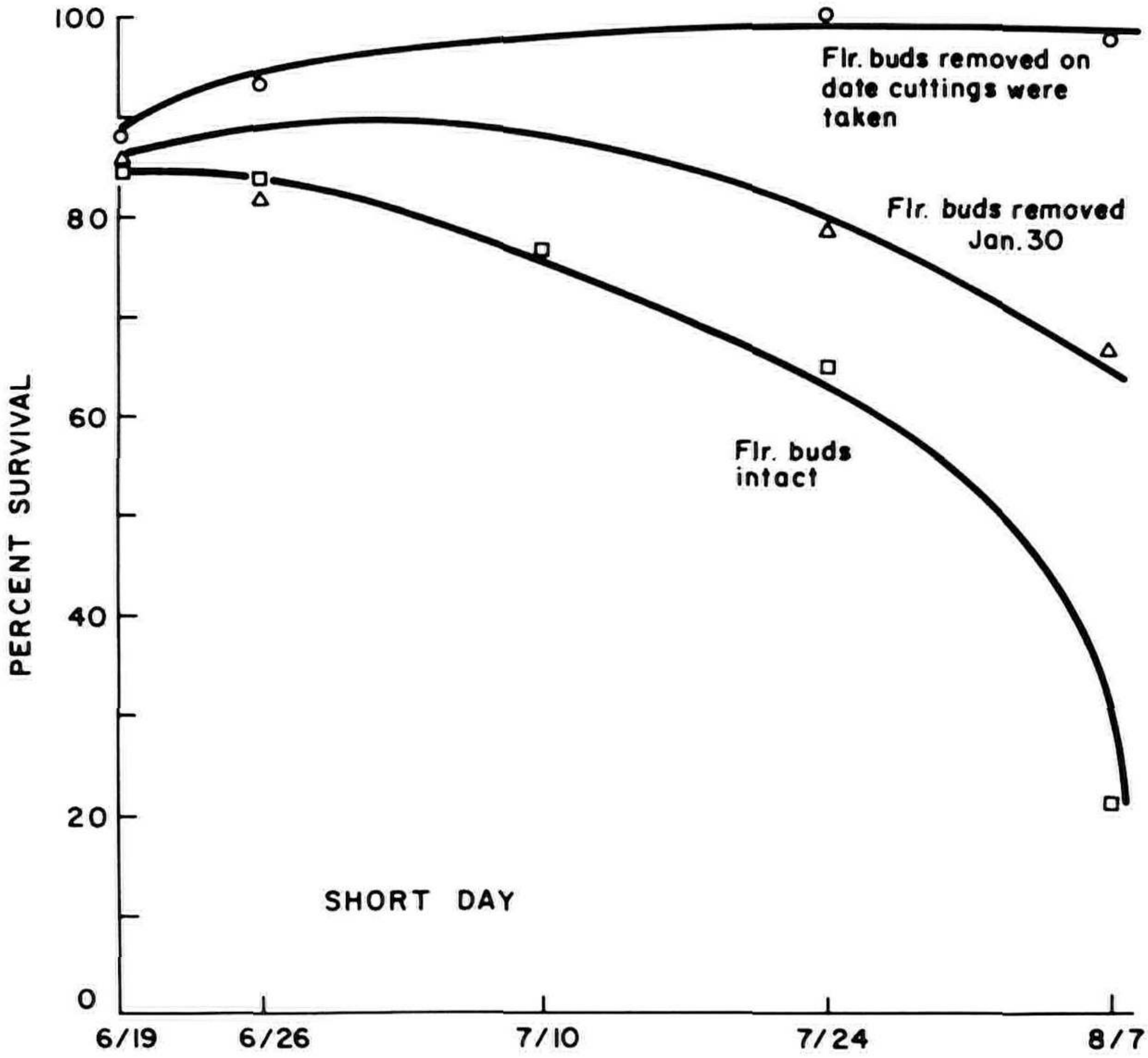

Fig. 7. The effect of the removal of flower buds on the survival of rooted cuttings of *Rhododendron mucronulatum* 'Cornell Pink'. The cuttings were subjected to short photoperiods during root initiation.

Relatively high rates of survival are attainable by:

1. Taking cuttings early in the spring before the flower buds are well developed.
2. Subjecting the cuttings to short photoperiods before the flower buds are fully developed.
3. Removal of the flower buds.

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JIM WELLS: Sid, I want to support entirely what you said. For years it has been our practice to take the terminal buds out of the cuttings of deciduous azaleas even though the cuttings are "butter-soft" when we take them. We find that this has a great effect upon the rooting and the subsequent development of the plant. Our cuttings are taken early in May, rooted by the first of July and immediately placed under supplemental light. We find it essential that there be no terminal bud because if it is left in they tend to form a flower bud right in the bench before they are moved and that is death. So I think it applies to a number of other plants in addition to 'Cornell Pink.

LES HANCOCK: I would also like to comment that I had trouble with *Rhododendron carolinianum* but I found that if you go over the parent plant a month before taking the cuttings and remove the terminal buds they rooted a lot better.

CASE HOOGENDOORN: Sid, do you apply lights to the cuttings when you stick them, or do you wait until after they are rooted?

SID WAXMAN: I have done both. It depends on which ones you are working with. Some are very slow to respond.

CASE HOOGENDOORN: I have found that the proper time to take cuttings of *Rhododendrons* such as 'Cornell Pink', is just when the first flush of growth is terminated. If the cuttings are taken then, they do very well.

SID WAXMAN: I have taken cuttings on up through August but I agree there are some varieties that are best taken just when the first flush of growth is terminated.

RALPH SHUGERT: Our next paper involves the vegetative propagation of sugar maple from cuttings. This paper is by John Donnelly and Harry Yawney.