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RECOGNIZING DEVELOPMENTAL STAGES IN SOUTHERN PINE FLOWERS:

The Key to Controlled Pollination

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Controlled pollinations are vital in southern pine tree improvement programs. Effective pollinations depend upon three operations. First, female flowers must be enclosed in isolation bags when they are in the proper stage of development. Then, viable pollen must be supplied to the ovules when the female flowers are most receptive. Finally, the developing cones must be protected until maturity.

The first two operations are highly dependent on recognition of the developmental stages of southern pine flowers. Timing of flower development varies among species and is highly dependent upon spring temperature. This booklet illustrates the developmental stages described by Cumming and Righter.[3] It also gives the pollination procedures to follow during each stage.

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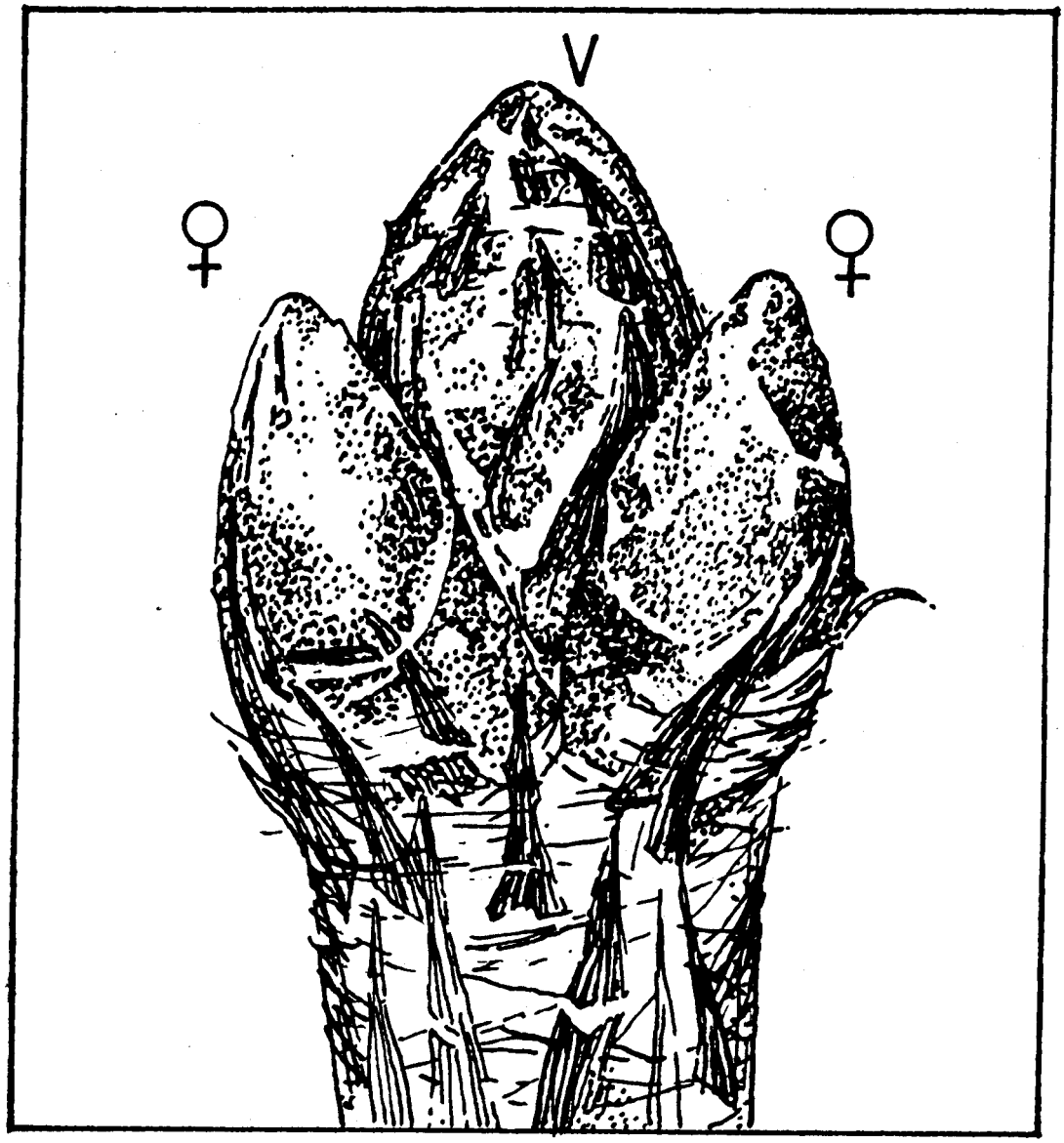
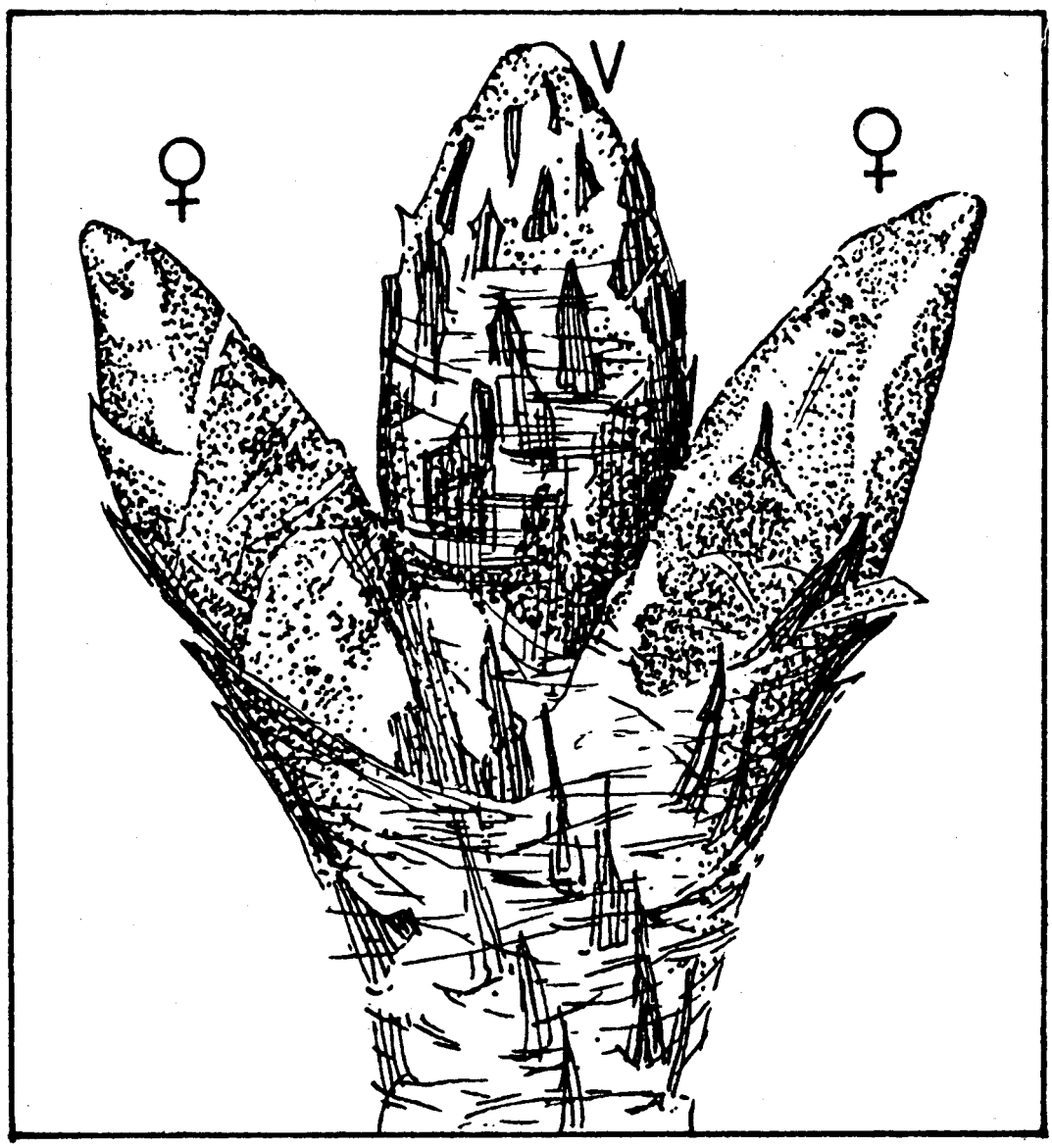
[3]Cumming, W.C., and F.I. Righter. 1948. Methods used to control pollination of pines in the Sierra Nevada of California. U.S. Dep. Agric., Circ. 792, 18 p. Washington, D.C.

STAGE 1



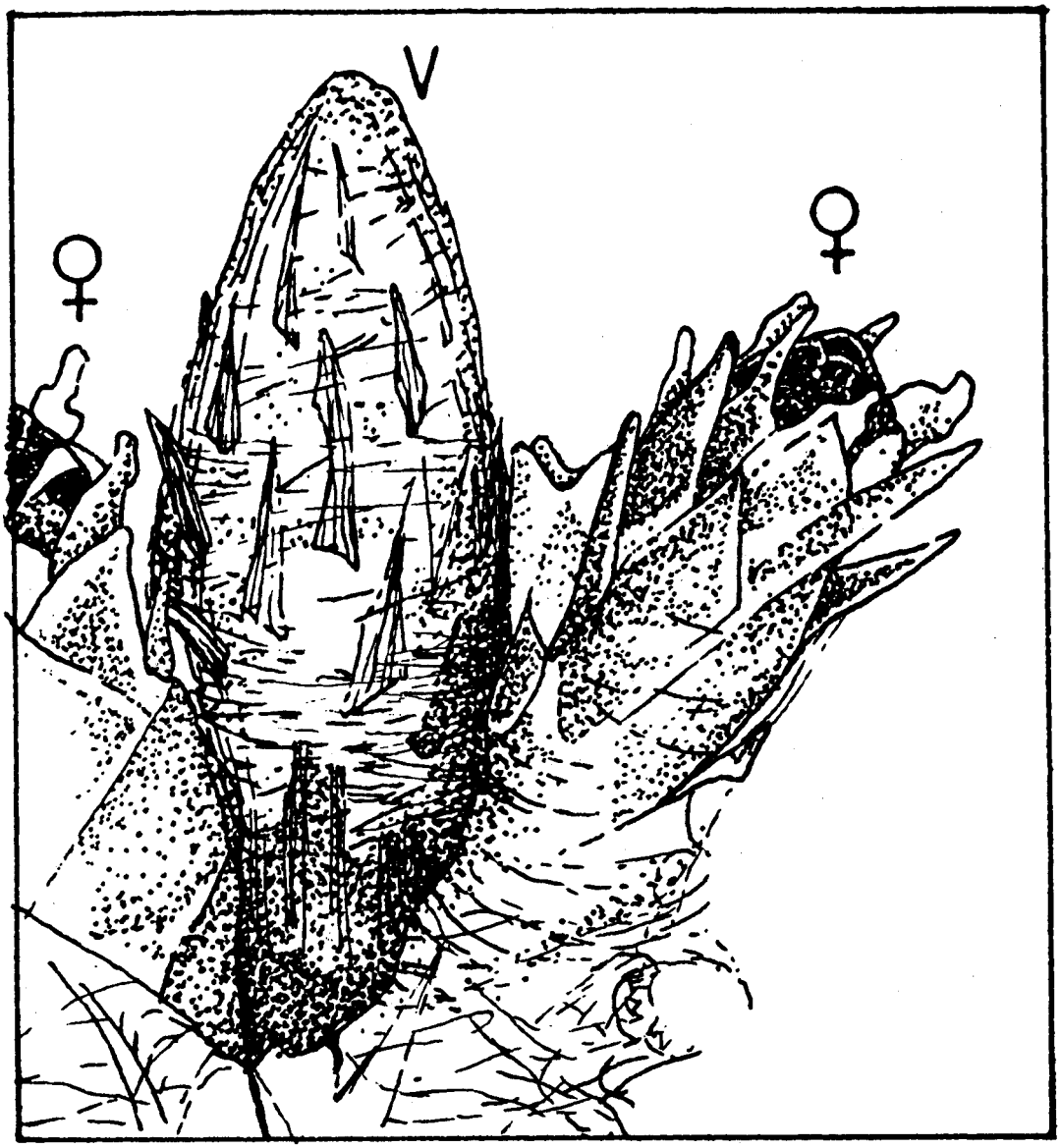
The female flower bud (♀) is small and tightly enclosed within the bud scales. One to several flower buds may occur in a lateral position on a vegetative shoot bud (v). This is a good time to identify potential branches for pollination, but it is still too early to bag the flowers. Bagging at this stage causes female flowers to be receptive before fresh pollen is available.

STAGE 2



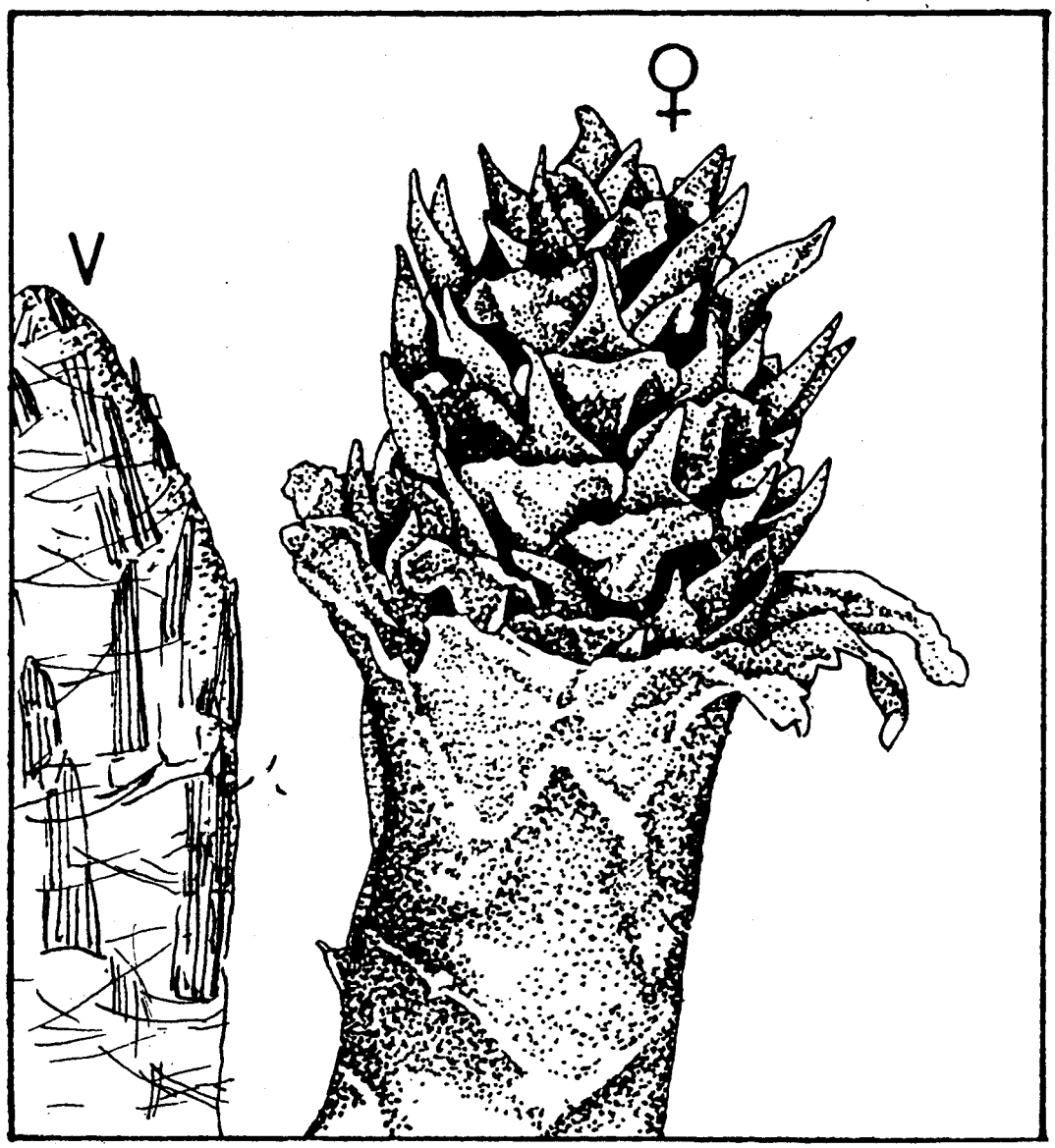
Flower buds have enlarged, but the flower primordia are still enclosed within the bud scales. Light-colored scales are noticeable at the tip of the bud. Isolation bags should be installed now.

STAGE 3



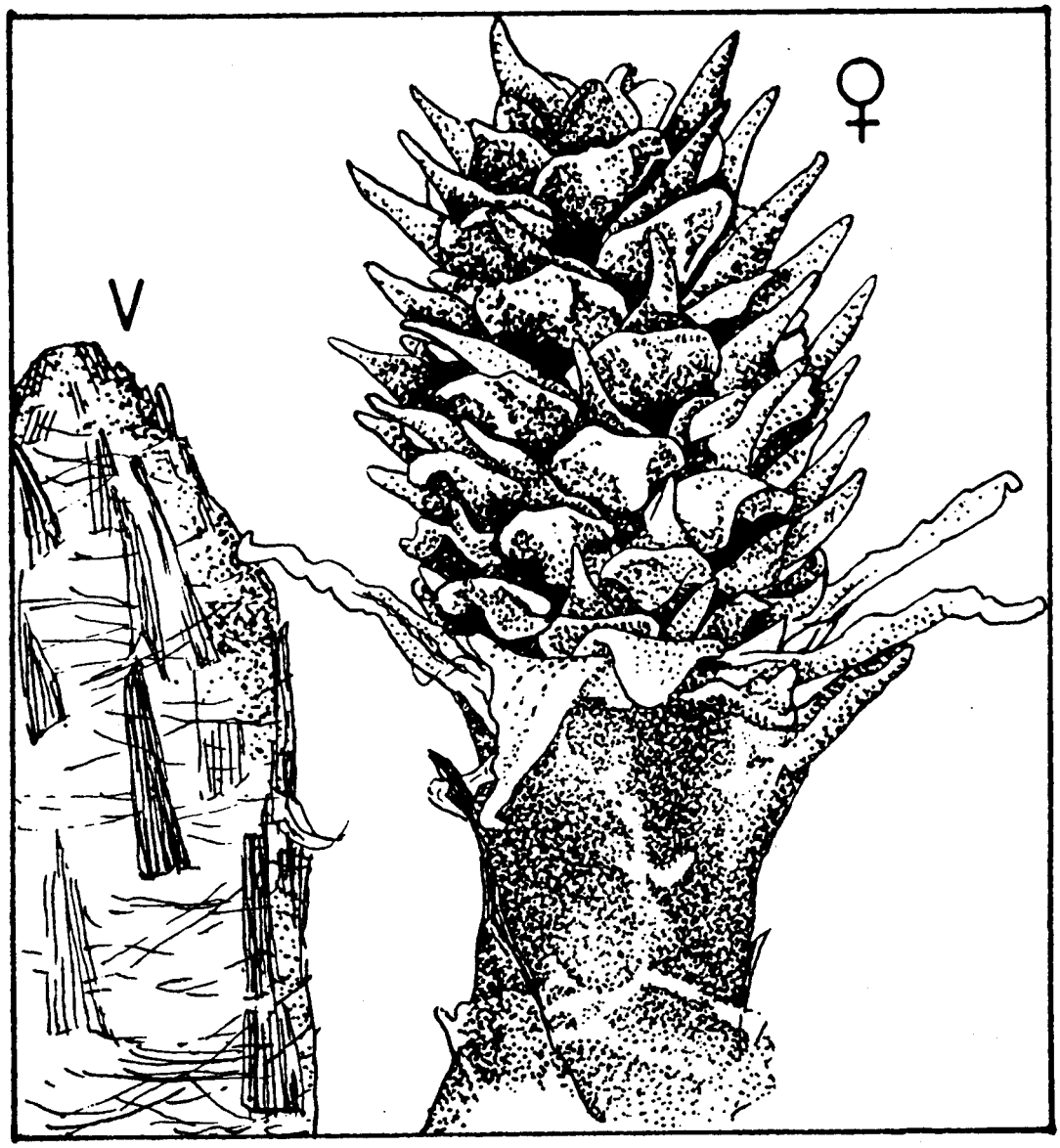
The flower has begun to emerge through the top of the scales. Flowers are normally red, pink, or light green. Since flowers may have received pollen of unknown origin, it is too late to bag.

STAGE 4



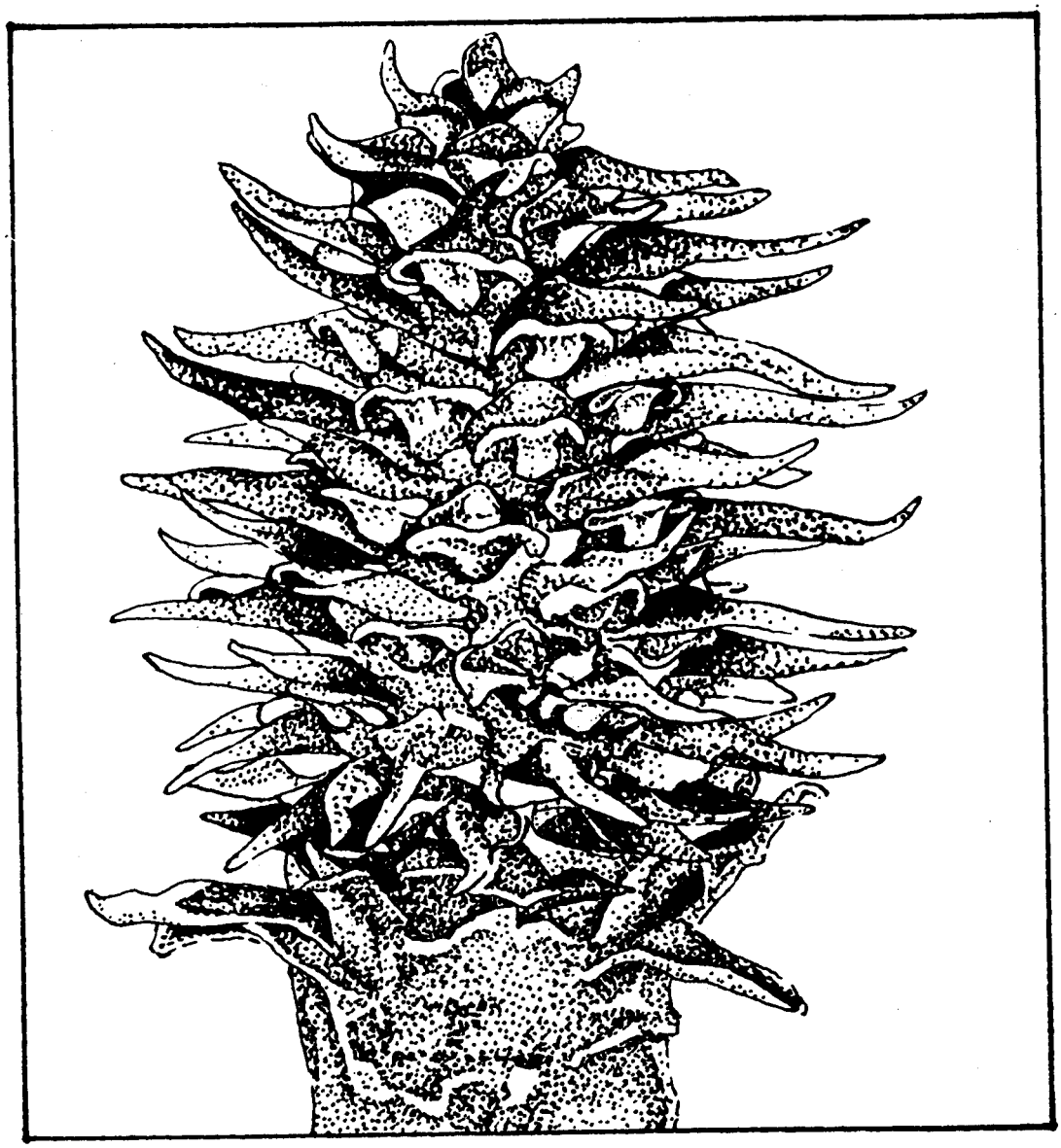
The flower has elongated and extends beyond the bud scales, but the lower one-third to one-half of the flower is still enclosed by the bud scales. Delay pollination.

STAGE 4 (late)



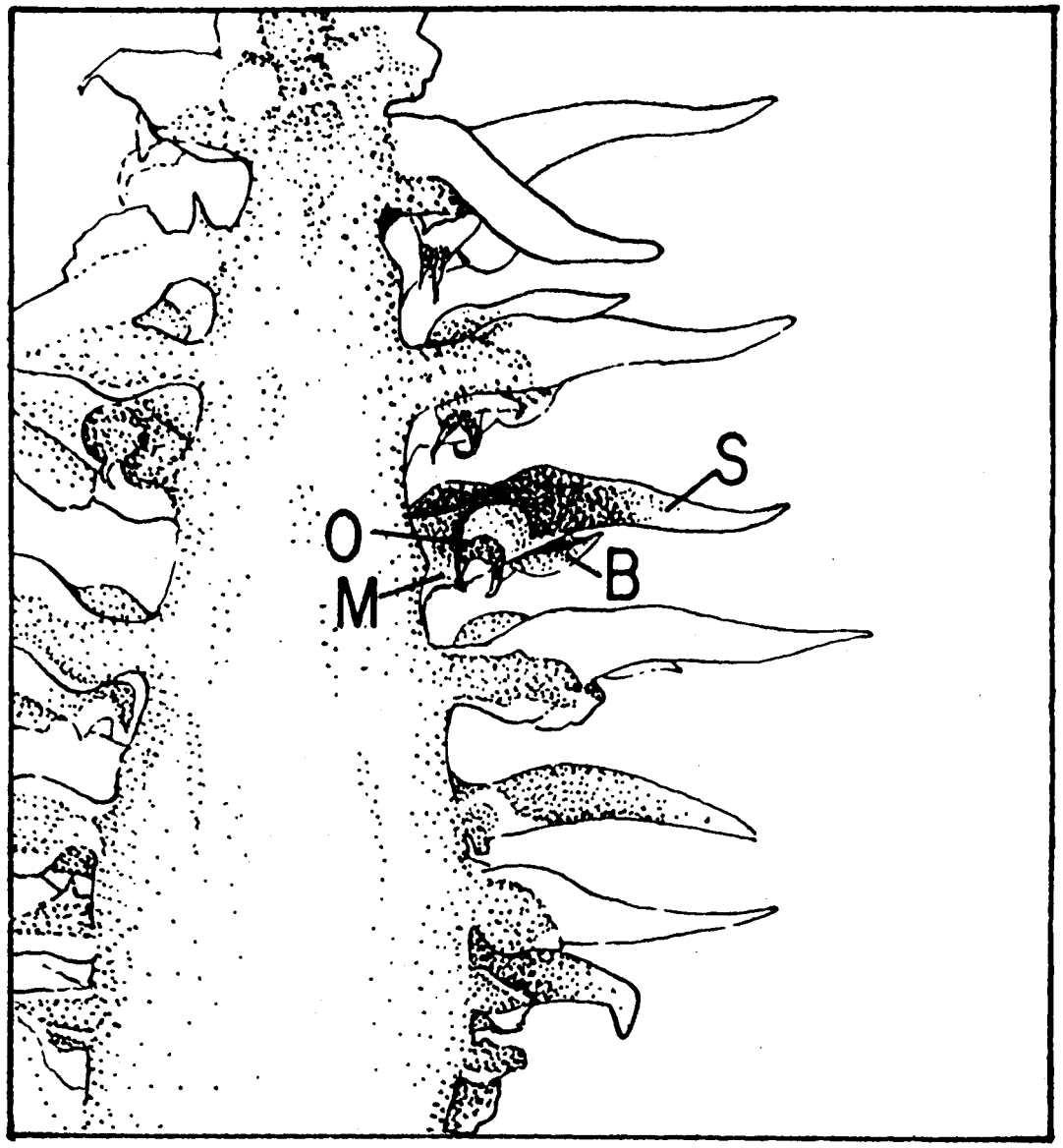
The flower has extended almost entirely from the bud scales, but the maximum space between the scales has not yet occurred. Some seed can be produced by pollinating flowers now, but yields are increased by delaying until stage 5.

STAGE 5



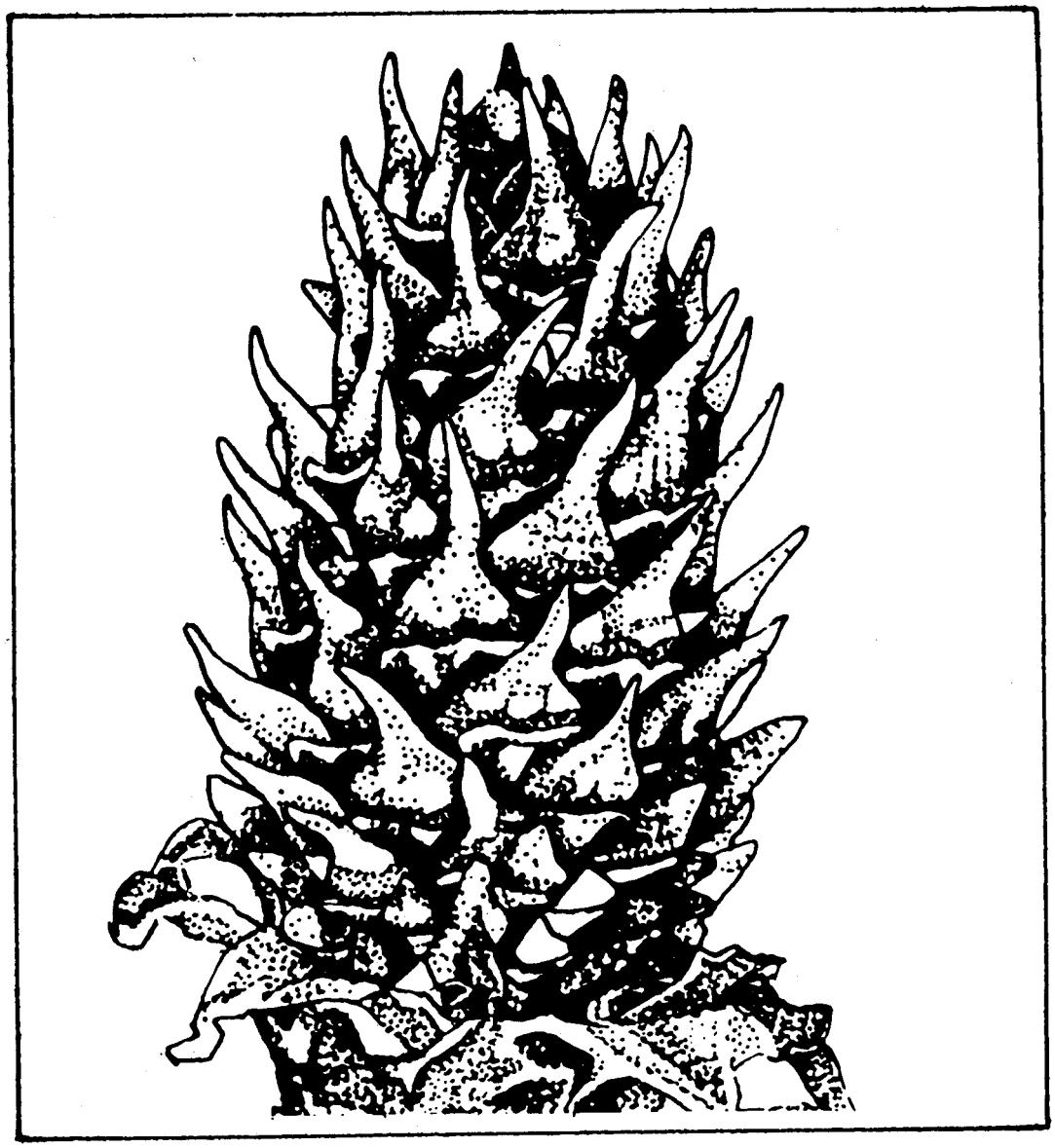
The flower has completely emerged from the bud scales. Typically, the bud scales are rolled back, and the flower scales approach a right angle with the axis of the conelet. The flower is at its maximum receptivity because the opening between the scales and the bracts offers the greatest access to pollen. Stage 5 normally lasts from one to several days. Pollinate at this stage.

STAGE 5 (cutaway)



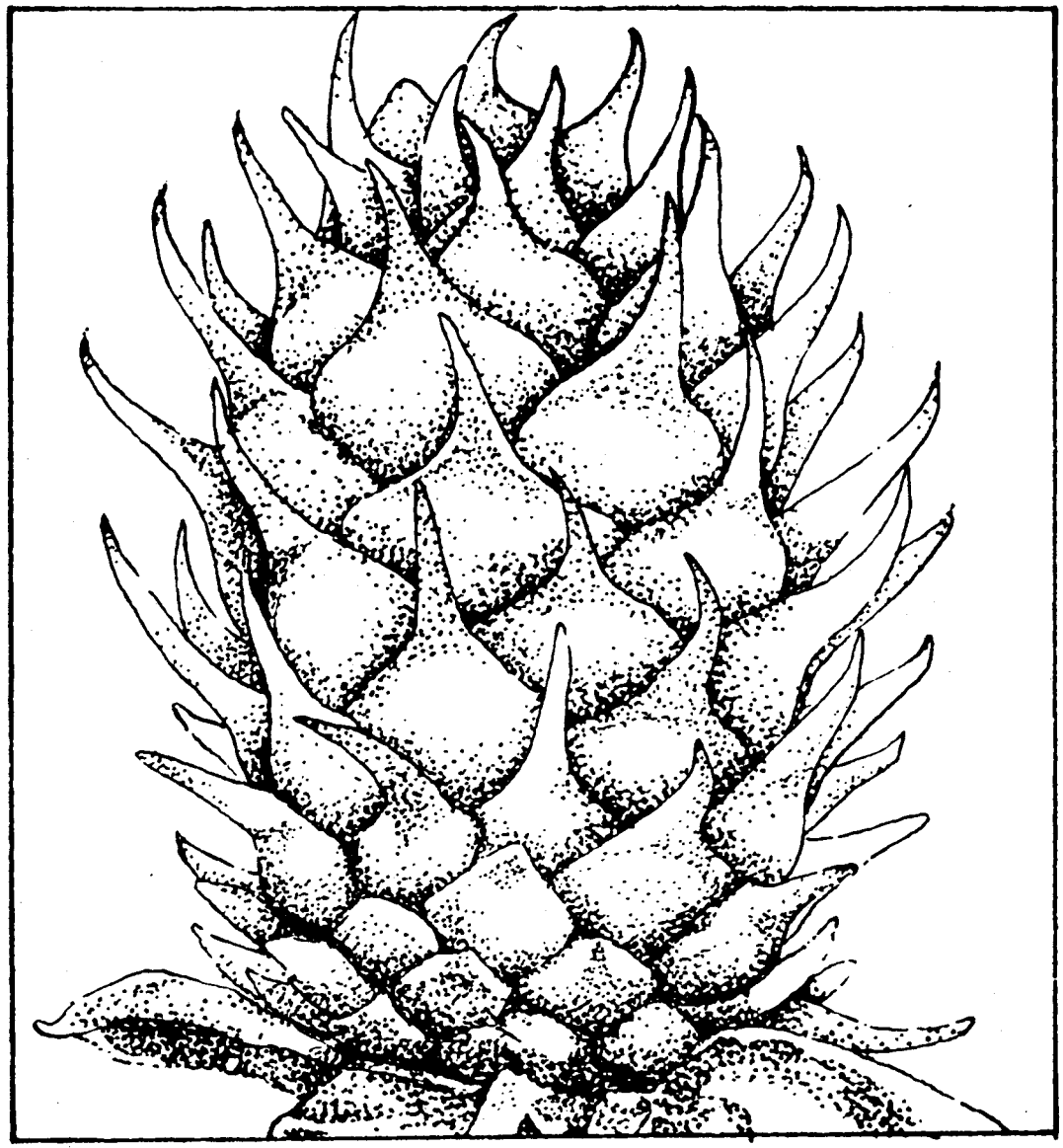
Pollen is wind-borne to the flower and enters the space between the scales (S) and bracts (B). Paired ovules (O) are embedded on the upper surface of each scale. The bracts are attached to the cone axis and the lower surface of the scales. The pollen accumulates around the sticky micropyle (M) of the ovule and is transported into the pollen chamber by a pollination droplet.

STAGE 5 (late)



The female flower remains receptive as long as the space between the scales is large enough for the passage of pollen. The scales gradually increase in size and after one to several days of receptivity (depending on the species and ambient temperature) the opening between the scales decreases until completely closed. Flowers may be pollinated in late stage 5, but seed yields may be low.

STAGE 6



The flower is no longer receptive because the growth of the scales completely closes the openings. Pollinations in stage 6 produce no seeds.

RECOMMENDED PROCEDURES FOR CONTROLLED POLLINATION

Bag flowers in stage 2 on strong vigorous branches. Earlier bagging may hasten female flower development resulting in receptivity before fresh pollen is available.

Do not bag flowers that have begun to emerge from the bud scales (stage 3).

Periodically check flowers for flower receptivity.

When flowers are in stage 4, delay pollination but observe frequently to determine onset of stage 5.

Inject pollen into bag when most flowers in the isolation bag are in stage 5.

Use pollen of highest viability available.

If stored pollen is used, test its viability before pollination.

Use an adequate quantity of pollen per bag (approximately 0.50 cm^3 per bag).

Try to achieve a good distribution of pollen within the bag. Shake bag after pollinating.

Do not try to pollinate all bags on the same tree on the same day if flowers are not receptive on some branches.

If flowers in different stages of development are in a single bag, pollinate a second time when late-developing flowers are receptive.

Delay bag removal until 2 weeks after final pollination.

Protect conelets with insecticides until cone maturity.

ACKNOWLEDGMENTS

Drawings prepared by Mary Wain Ellison, commercial artist, Macon, Georgia. The drawings were made from photographs taken by J.G. Hutchinson when he was with the Southeastern Forest Experiment Station, Charlottesville, Virginia. Hutchinson is now with the North Central Forest Experiment Station in St. Paul, Minnesota.

The material in this booklet is adapted from Chapter 10, "Controlled Pollination," in *Pollen Management Handbook*. E. Carlyle Franklin, Editor. USDA Forest Service.