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Original Article**Artificial Bud (Spur) Extinction (ABE/ ASE); Thinning Method in Apple that Imitates Natural Bud extinction by Manually Removing Buds before Bud break****S.N. Kirmani¹, W. H. Raja², J. I. Mir³ and Kounser Javeed⁴**¹*SMS Horticulture- ICAR-KVK, Baramulla*²*Senior Scientist, ICAR CITH Srinagar*³*Principal Scientist, ICAR CITH, Srinagar*⁴*assistant professor, skuast kashmir***Corresponding author: shoaibkirmani@gmail.com**Received: 13/06/2026**Published: 16/06/2026*

Artificial Bud Extinction (ABE)—also known as Artificial Spur Extinction (ASE)—is a precision crop load management technique. It involves manually removing floral buds during late dormancy or right before bud break to systematically reduce total bud density. This mimics natural bud drop, prevents biennial bearing, and improves fruit size and color.

Crop load management is one of the very important aspect in modern apple (*Malus x domestica* Borkh.) production to ensure regular bearing and good fruit quality. Thinning early in the season, before cell division is complete, enables maximization of carbohydrate availability, optimizing yield and fruit quality and reducing the risk of biennial bearing. The standard industry practice for crop load management in many countries is based on chemical thinning, applied during the bloom and post-bloom periods, followed up with hand thinning. However, the response to chemical thinning is very weather-dependent and there is considerable variation between cultivars in sensitivity to thinning chemicals.

This lack of predictability, combined with an increasing awareness of the environmental impact of many chemicals and the loss of registration of some chemicals, points to a need to find alternate environmentally acceptable methods for managing crop load. Mechanical thinning has advantages in that the thinning result is immediately visible and environmental conditions do not affect efficacy. However, there are also disadvantages such as damage to trees, lack of selectivity, and the risk of spreading disease. For mechanical thinning to be effective, tree architecture needs to be suited to the particular machine and the orchard floor needs to be clean and level and is recommended that, for future adoption of mechanical thinning, new orchards should be established with mechanisation in mind.

In cultivars, exhibiting high natural spur extinction, defined as natural abortion of a proportion of growing buds, the remaining floral structures bear fruit and produce bourse shoots that flower the following season, known as the bourse-over-bourse phenomenon. Cultivars characterised by alternate bearing can be encouraged to produce more regularly by reducing the number of axillary shoots along the branches.

This is the basis of artificial bud extinction (ABE), which imitates natural bud extinction by reducing bud density through manual removal of floral buds during late winter or early spring. Buds are preferentially removed from the underside of limbs and shaded areas of the canopy. This allows for precision crop load management as it precisely defines not only how much fruit is set on each limb of the tree, but also where it is positioned. The concept of ABE was developed from architectural knowledge that cultivars with a regular bearing habit are associated with the annual extinction of a proportion of their meristems. ABE involves removing excess floral buds on individual branch units within the canopy, typically during late winter or early spring near bud-break. ABE aims to thin floral buds of each branch unit to a predetermined density, leaving only the most productive floral buds, including spurs and terminal buds of short to medium-length annual shoots. Floral buds in positions of optimal light, such as on the top or side of the branch, are left preferentially to those buds underneath the branch that are more shaded. Lowering floral bud density using ABE is thought to optimise the allocation of finite carbon reserves and new assimilates during early fruit development into only the minimum number of sinks required to produce a desired harvestable yield. Consequential responses of lowering the carbon demand of reproductive sinks at the earliest point possible during the growing season could include enhancement of fruit set, fruit size and quality, return bloom, and a more desirable balance between reproductive and vegetative development.

Total dry matter production by apple orchards is positively related to light interception. Consequently, maximising light interception is important in commercial apple orchards, as it directly affects tree growth and yield. Artificial spur extinction (ASE/ABE) is a method of crop load control that reduces the density and alters distribution of floral buds in whole trees. Because ASE reduces total bud numbers on the tree, total light interception has been found to be affected. Light interception of unmodified trees increased from ~30% at 2.5 weeks after budbreak (WABB) to ~60% at 8 WABB and thereafter did not change until leaf-fall. Prior to 8 WABB, light interception by trees set at ASE 6 did not differ from that by the unmodified trees. In trees set at ASE 4 and 2, light interception was initially lower (25.7 and 22.7% respectively) than other treatments and this effect lasted until 5 WABB in ASE 4 and 8 WABB in ASE 2. At full canopy, trees managed with ASE intercepted ~4% more light than unmodified trees. Higher light interception of ASE trees is probably because ASE stimulates a higher proportion of fruiting spurs to produce short- to medium-length annual bourse shoots with greater leaf area than spur bourse buds.

Because the bulk of the thinning is completed prior to flowering, there is minimal resource wastage in ABE-managed trees. Hence, fruit size is greater than in conventionally-managed trees. There is also a positive response in fruit set of individual buds with the proportion of buds failing to set fruit being reduced and an increased proportion of buds setting multiple fruit. With the elimination of shaded laterals and improved light distribution within the tree canopy that results from bud

extinction not only improves fruit quality, but also promotes bud organogenesis, resulting in higher return bloom and reducing the risk of biennial bearing.

Results from several trials demonstrated consistent fruit set of both Gala and Fuji apple under ABE management compared with conventional management. Fruit weight was increased in all ABE treatments from 5% up to 38% and reduce biennial bearing risk by 50% in thinned trees. Studies also reveal that ABE is a feasible alternative to chemical thinning, improving reliability of crop load management with increased predictability of fruit size and yield. Trees are significantly thinned before flowering, controlling biennial bearing. In addition, bud position is optimised, fruit is well spaced and light distribution into the canopy is enhanced. In terms of costs, implementation of ABE is comparable to managing crop load with CT programs but has the advantage that crop load management costs reduce in subsequent years after the initial tree set-up. ABE is also suitable for use in organic apple orchards.

Step-by-Step Execution Guide for ABE/ASC

1. Perform Standard Winter Pruning First

Artificial bud extinction does not replace winter pruning. Before removing individual buds, prune your apple trees to establish optimal architecture, spacing, and light penetration.

Target: Keep about 6 limbs per meter of tree height and ensure they are evenly spaced around the trunk.

2. Time Your Extinction

The ideal window for this technique is late winter to just prior to spring budbreak (often during the pink bud or green tip stages). At this time, you can clearly distinguish between fatter, fuzzy floral buds and thinner, pointed vegetative buds.

3. Prioritize Bud Selection (The "Hierarchy")

When deciding which buds to remove and which to keep, follow this fruit-quality hierarchy (from best to worst):

Terminal Buds: These are found at the very end of shoots and consistently yield the highest fruit quality. Aim to keep terminals where possible.



Spur Buds: These grow on older wood and yield good fruit, though slightly less optimal than terminal buds.

Axillary Buds: These are on first-year wood. They produce lower-quality fruit and should generally be removed.



4. Remove the Extraneous Buds

Using your fingers, clippers, or specialized tools, systematically go through the limbs and perform the following removals:

Under-limb buds: Remove all buds located on the underside of branches. These are heavily shaded and result in poorly colored, low-quality apples.

Axillary buds: Strip all auxiliary flower buds on first-year wood.

Excessive spurs: If a branch has too many flower buds, thin the spurs to achieve a specific target (e.g., 4 to 8 fruits on smaller branches, 12 to 15 on larger branches).

5. Adjust for Limb Vigor

Adapt your extinction intensity depending on the thickness and vigor of each individual limb. Many commercial growers utilize specialized measuring tools (such as the MAF cot wheel) to measure branch sizes and determine the precise floral bud count, the limb can physiologically support.



MAF cot wheel