Lodging represents a significant risk in intense cereal production with high nitrogen application rates, especially under the maritime climatic conditions prevailing in major parts of Europe. In addition to the availability of water and nutrients, lodging is also influenced by cultivar and husbandry factors including sowing date, seed rate, and drilling depth. Apart from losses in yield, which usually lie between 20 and 40%, grain quality is adversely affected and mechanical harvesting is considerably hampered. A number of growth retardants are known that reduce stem length, thereby lowering the leverage of the ear and other parts of the shoot. Increased stem stability also results from histological changes in the stem wall caused by such PGRs. Improved root growth induced by some compounds may further improve lodging resistance. Products available on the market are based on inhibitors of gibberellin biosynthesis (chloromequat chloride, mepiquat chloride, trinexapac-ethyl, prohexadione-Ca) and the ethylene-releasing ethephon. With the introduction of chloromequat chloride, especially suited for wheat, an important contribution to secure yield and quality has been made. Since its commercialization in 1965, CCC has become the most widely used PGR. Still today the application of this compound in combination with increased nitrogen dressings is a standard practice in most wheat growing areas of Europe. In the UK, for instance, more than 90% of the wheat acreage is treated with this stem stabilizer. The other active ingredients have been introduced since the 1980s. Ethephon is of particular value in barley. Trinexapac-ethyl and prohexadione-Ca allow for more sophisticated approaches and are primarily used when yield levels of 10 tons per hectare or above are targeted.

Proper tree growth management is of major concern in commercial pome fruit production: Avoiding excessive shoot growth will induce earlier flowering and fruiting in young trees. Older trees have to be contained to their allocated space, thereby reducing crowding and shading. The crowns of fruit trees should be sufficiently open to allow good light penetration to the inner parts of the canopy, thereby improving photo productivity and fruit coloration. Additionally, efficient crop protection is significantly facilitated in such trees. Since the beginning of professional apple and pear production, several techniques have been employed to avoid excessive shoot growth: Different types of dwarfing rootstocks and scions have become available particularly for apple. Different cultivars may also show significant differences in shoot vigor. Dormant and summer pruning are the main cultural practices for shoot control in addition to regulation of fruit set. Other methods include: root pruning, root restriction, stem girdling or stem sawing, limb bending, breaking or wounding and restrictive fertilization and irrigation. However, any of these methods is cost-intensive and/or bears a high risk of failure. Furthermore, part of the trees’ assimilates or potential assimilates are lost.

Chemical regulation of shoot growth is practiced since many years by using distinct inhibitors of gibberellin biosynthesis as growth retardants. Daminozide has been widely used since the early 1960s. However, health concerns have led to a general ban of this compound in edible crops in the late 1980s. For several years, only paclobutrazol and uniconazole-P remained registered as regulators of shoot growth in fruit trees in a relatively small number of countries. Products based on prohexadione-Ca have been introduced to many countries since the year 2000. Prohexadione is a structural analog of 2-oxoglutarate and ascorbate and as such blocks distinct dioxygenases, which require these compounds as a co-substrate. Prohexadione inhibits GA$_{20}$-3ß-hydroxylase and related enzymes involved in late stages of gibberellin metabolism, aminocyclopropylcarboxylic acid oxidase in ethylene
formation and flavanone 3-hydroxylase and related enzymes involved in flavonoid biosynthesis. As a result of lowered levels of growth-active gibberellins, treated trees display less shoot growth and require significant less work for dormant and summer pruning. Inhibition of ethylene formation in conjunction with the availability of assimilates no longer needed for shoot growth often leads to increased fruit set and fruit yield. If flavanone 3-hydroxylase is blocked by prohexadione, pome fruit trees and other plant species start producing 3-deoxyflavonoids, such as luteoforol and luteoliflavan, which do not normally occur in these plants. Luteoforol shows clear in vitro biocidal activity against a number of bacterial and fungal pathogens, including Erwinia amylovora and Venturia inaequalis, the causal agents of fire blight and apple scab, respectively. The triggering of such phytoalexin-like compounds explains primarily why treated pome fruit trees are significantly less affected by diseases. However, one should not rule out that other effects caused by prohexadione-Ca, e.g. earlier bud set and a thicker leaf epidermis, are also of relevance. Most likely, these mechanisms are also the cause of lowered incidence of aphids and other insect pests in trees treated with prohexadione-Ca.