

HOW DO HARVEST AIDS WORK?
J. T. Cothren and T. K. Witten
Texas Agricultural Experiment Station
College Station, TX

Abstract

Cotton (*Gossypium hirsutum* L.) is inherently a woody perennial that has been selected and bred for growth in an annual cropping system. The plant possesses a natural process for shedding of leaves, but this process is not necessarily synchronized with the most appropriate time of the season for timely harvest of the crop in its natural environment.

Leaf shed occurs because of a genetically programmed process called senescence, which roughly equates to aging. Senescence is controlled by the ratio of five naturally occurring hormones produced by plants: auxins, gibberellins, cytokinins, abscisic acid, and ethylene. Auxins tend to keep plants in the juvenile or immature stage of growth and thus inhibit senescence. Abscisic acid and ethylene promote senescence. Gibberellic acid and cytokinin effects tend to be more variable.

During the latter stages of senescence, plants exhibit reduced levels of chlorophyll, an accumulation of anthocyanin, and a remobilization of sugar and nitrogenous compounds that have been broken down. An increase in ethylene levels reduces the movement of auxin to the distinct layer of cells known as the abscission layer located at the base of the leaf petiole. In addition, ethylene enhances the enzymatic activity of pectinase and cellulase, which hydrolyze the components of the cell walls in the abscission layer. Subsequently the leaf shears at this abscission layer and falls from the plant.

The need for harvest aids in cotton production, which arose during World War II, was necessitated by a shortage of hand labor, initially used to harvest the crop. Due to this labor shortage, efforts were made to machine-harvest the crop. The introduction of machines created a need for leaf removal to increase the efficiency of harvest, to minimize leaf stain, and to optimize lint yield and quality.

Different types of harvest aids are needed for 'picker' versus 'stripper' type cotton. Picker cotton is usually treated with a defoliant to remove the leaves. Defoliants are generally of two types: hormonal and herbicidal. Defoliants are less harsh than desiccants. Desiccants cause injury that leads to rapid moisture loss and drying of the leaves. This injury occurs before the abscission layer has adequate time to form, and subsequently leaves 'stick' to the plant.

Herbicidal defoliants, such as tribufos and dimethipin, injure the leaf causing an ethylene cascade that impedes movement of auxin to the abscission zone and that also enhances cellulase and pectinase activity. Hormonal defoliants, such as thidiazuron, increases ethylene production that produces similar responses to the herbicidal defoliants. Desiccants, such as paraquat, interfere with the chloroplast integrity, by intercepting electrons that eventually lead to energy production. Free radicals of oxygen combine with molecular oxygen to produce a very reactive molecule, superoxide, that disrupts membrane activity. Moisture loss occurs rapidly and the leaves are desiccated. Some harvest aids, such as Ginstar[®], exhibit both defoliating and desiccating properties. Ginstar[®] is a combination of thidiazuron and diuron.

Boll openers are ethephon-based products that increase ethylene release which leads to splitting of the carpel (boll) walls, a subsequent drying or dehiscing of the carpels, and opening of the boll. Finish[®] is a combination

of ethephon and cyclanilide, an auxin transport inhibitor and acts as a synergist to enhance ethephon activity.

Additives such as adjuvants, surfactants, activators, and conditioners can increase activity of harvest aids by increasing their uptake. Also, tank mixes of diverse harvest aid chemistries can enhance activity, reduce rates, and give more consistent responses.