## Fractional Harvest: A New Way to Separately Harvest Alfalfa Leaves & Stems

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Most producers hate the thought of alfalfa leaves being knocked off the stem during harvest, but this is exactly the goal of a new way of harvesting. The very first step in "fractional harvest" is stripping leaves from the stem.

Fractional harvest means the plants are harvested in different segments based on their physical properties or value. For instance, most grain crops are "fractionally harvested" when the valuable grain is separated from the less valuable straw or stover. The combine performs a fractional harvest by threshing, separating and cleaning the grain while ejecting the straw or stover. This process is often completed by baling the straw or stover after it has dried. The two most important forage crops in the Midwest are alfalfa haylage and whole-plant corn silage. The valuable plant fractions are the protein-rich alfalfa leaves or the energy-rich corn kernels. The high-fiber stem or stalk is less valuable but is important roughage for rumen function. Since ruminant animals need both protein and roughage, forage crops are harvested as whole-plants rather than by fractional harvest. However, when rations are balanced for dairy cattle, it would be easier to optimize a balanced ration utilizing haylage if the high-fiber stems. The objective of harvest fractionation is to take better economic advantage of the different values of the leaves and stems.

Producing high-quality forage is a challenge in the Midwest. Weather delays before cutting reduces quality due to over-maturity. Producer frustration with inability to consistently produce high-quality alfalfa silage has caused an industry-wide shift toward producing and feeding more whole-plant corn-silage and less alfalfa haylage. Harvest fractionation allows the producer to remove the high-value leaves at harvest. Leaves are not exposed to field wilting, so weather related losses will be low. Stems gain fiber as they mature, but leaves have a consistent nutrient composition even as the plant matures. If leaves and stems are harvested and stored separately, an optimum nutritional composition for each stage of lactation or animal group can be achieved by blending the right amount of leaves and stems in the TMR.

The mechanism for harvest fractionation involves a newly developed stripping rotor with hundreds of tines to penetrate the crop canopy and strip the leaves from the stem. The leaves are collected from the rotor and blown directly into a wagon or truck. The machine is simple and low-power, so equipment and operating costs are low. The high- and low-value fractions are separated cleanly and immediately at harvest. About 90% of the total leaves in the field are harvested in the stripped fraction. In early tests, stripped material was 27% CP and 23% NDF, while remaining stem material was 13% CP and 55% NDF. The amount of leaves stripped from the stem can easily be controlled by adjusting rotor speed and rotor height.

The most challenging aspect of this process is how to store the leaves. Typically the leaves will be 70-80% moisture when removed from the stems, which is too wet to be safely stored by direct- ensiling. Leaves ensiled in this moisture range will not only spoil due to undesirable fermentation, but there would be concerns about silo effluent. Research is currently focused on finding cost effective and practical ways to direct-ensile the leaves. Studies have looked at direct ensiling with amendments like DDG to decrease product moisture or using additives to prevent undesirable microbial action. Once cut, stems dry quickly since stripping intensively conditions the stem and the windrow density is low since almost half the plant is removed with the stripped material. In most cases the stems can be wilted to harvest moisture in just a few hours after stripping, making a single-day harvest a reality.

Harvest fractionation of alfalfa has another exciting use. Stems are an excellent cellulosic biomass. This harvesting system could be used to simultaneously harvest a highly nutritious animal feed and a valuable biomass feedstock.

Harvest fractionation of alfalfa is not yet a reality. There is important work to be done to improve machine performance prior to making it a viable commercial product. For this to become widely adopted, the research on direct ensiling the leaf fraction must be successful and the process must be economical and practical.