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STAR accelerated lambing is associated with more efficient use of high quality pasture and conserved forages. Improved efficiency is based on the reduced time that a dry ewe remains open and the resulting greater number of lambs weaned annually with the same annual maintenance feed requirement.

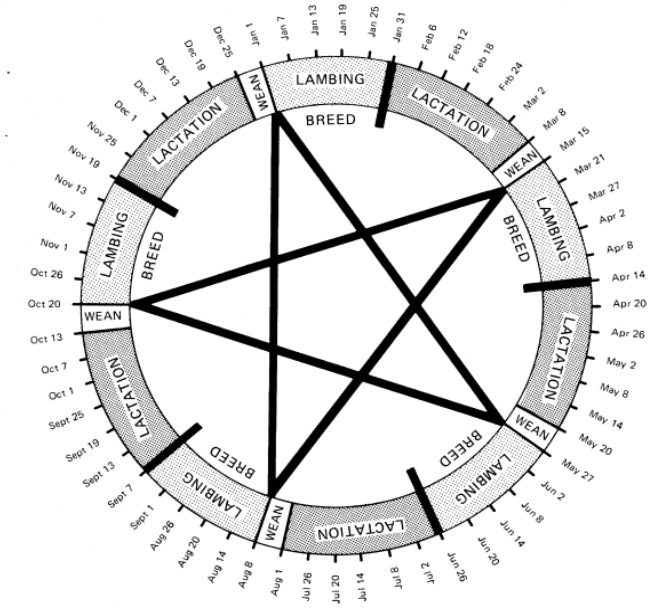

Figure 1. STAR© management calendar

The STAR System was also designed specifically to facilitate efficient management of a single dry flock and five back-to-back lambing-lactation flocks over which to spread fixed costs such as equipment and housing. Within the dry flock, the coincidence of late gestation for one group with pre-breeding flushing for another group allows all dry ewes to be fed appropriately as a single flock on pasture. Several weeks preceding breeding and lambing, the dry flock is flushed with the highest quality pasture available. This means that during each of the five 73-day periods there are times when the dry flock can utilize pasture of maintenance quality (after breeding) as well as the highest quality pasture preceding lambing and breeding. Except for the January season, the other four lactation periods of the STAR system can be sustained predominantly on grazed forages.

The ability of a STAR accelerated lambing flock to utilize high quality winter preserved forages has led to the development of an extended fall and winter grazing season that results in year-round grazing (Figure 2). Grazing the dry flock through the fall and winter takes advantage of low-cost, high quality fall aftermath feeds and provides exercise which makes for easier lambing. Because highly productive ewes often lose some condition during late gestation and early lactation, there is a great economic advantage in rebuilding the condition of these ewes on inexpensive fall

Figure 2. Ewes grazing fresh fall forage preserved by frost and snow. The idea to winter-graze sheep came from the observation that deer (on hillside) pawed through the snow to obtain high-quality forage.

regrowth of hay fields and permanent pastures. The early fall regrowth preserved by snow cover is often better quality than conserved forage (Table 1) and also requires less labor to feed, less housing and bedding, and results in less manure to clean and spread. The reduced exposure to disease, the high quality, free-choice diet, and excellent exercise makes lambing ewes that have just come off pasture a pleasure compared to lambing ewes that have been confined in late gestation.

Table 1. Ewe nutrient requirements compared to conserved and fresh forage analyses.

Item	TDN	Crude protein	Ca	P	ADF	NDF	Moisture required at 45°F
	---------- % ----------						% of total intake
Nutrient requirement of 154 lb twinning ewe (NRC, 1985)							
Flushing	65	11.3	0.4	0.24			67
Last 4 weeks gestation							83
First 15 weeks gestation	55	9.3	0.25	0.20			67
Lactation for 6 weeks with twins	65	15	0.39	0.29			Free choice
Conserved forages, dry matter basis							
Alfalfa hay, first cut	57	16	1.77	0.23	43	59	10
Alfalfa silage, second cut	60	20	1.25	0.39	41	53	45
Corn silage	68	8	0.23	0.22	30		70
Fresh pasture, dry matter basis							
Alfalfa in October	72	20	0.87	0.37	20	31	74
Bluegrass in October	74	18	0.64	0.43	23	43	82
Timothy, vegetative in February	67	21	0.98	0.33	32	56	89
Timothy, vegetative in March	76	21	0.56	0.38	21	32	67
Timothy, boot stage in October	68	14	0.68	0.35	30	53	64
Orchard grass, vegetative in February	67	21	0.98	0.33	32	56	89
Bluegrass in March	73	19	0.49	0.35	24	39	56

The two most common reasons given by others for not extending the grazing season - difficulty in supplying water or difficulty in moving fencing in frozen ground - have never prevented our sheep from grazing (see Trouble Shooting section). Extended grazing has been greatly facilitated by innovations in portable electric fencing such as livestock netting and quick fence (a system using fiberglass posts and lightweight, spring-tightened braided wire). A portable windbreak made from Netlon built into a series of interconnected 6-½ foot sections framed in schedule 80 one-inch PVC piping has proven invaluable as a shelter from wind and drifting snow.

Careful planning of which fields to use first contributes more to successful winter grazing than the severity of the winter. In fact, the earlier colder weather sets in and the longer the snow lasts before a January thaw, the greater are chances of extending the grazing season until spring. An excess of a one foot of snow accumulation is generally prohibitive to grazing. At times of heavy

snow accumulation, wind assists in keeping flat and high ground open. Heavy icing during warm spells is the only other major limitation at snow depths of less than one foot. Low temperatures in themselves are not a problem; usually sub-zero temperatures are accompanied by clear, calm weather, which is good for winter grazing.

Planting a crop specifically to extend grazing through the winter should only be done after using as much hay aftermath as possible. Look beyond your own property. Readily available neighboring hay fields may be grazed at a cost of 1-½ cents per ewe per day. One neighbor has been able to pay property taxes with the income from grazing fees. Other neighbors make their property eligible to be taxed at the reduced agricultural rate by signing a five-year agreement to have sheep graze their fields.

An Extended Grazing Season

An outline of the one extended grazing season provides an example showing how the STAR System and extended grazing fit together. For more variations, see the section on Guidelines and Trouble Shooting that follows.

To allow permanent pasture regrowth from September through November, planning for fall and winter grazing season started in August with permission being granted from neighbors to use hay field regrowth from predominantly grassy fields that would not grow sufficiently to be harvested mechanically. We started in fields that are several miles away from the lambing barns and gradually move the flock towards the barns. All ewes were wormed when they left permanent pasture to go on hay fields and they remained worm-free through the fall and winter.

The sheep were trucked to the temporary pasture to make them lose track of how to get home. That way, they were more likely stay within the temporary electric fence. To acclimate deer to stay away from the electric fence, the temporary fence was constructed and charged at least one night before the sheep were trucked to the fields.

In early October, areas with more alfalfa were grazed as a pre-lambing and pre-breeding supplement for the dry flock. Several days preceding the October lambing period, all ewes were trailed to the barn and sorted by palpation of their udders to detect and remove those due to lamb in the October-November lambing period. Ewes weaned from August-September lambing were added to the dry flock. By this time, fields with the most mature alfalfa were grazed on a 3- to 4-day rotation. By mid-October, most crop farmers had given up harvesting alfalfa due to wet field conditions. At that time, fields that were predominantly alfalfa had frozen at least once so that they could be safely grazed without worry of bloat. In addition, the alfalfa was sufficiently frozen to have stored all root reserves for optimal winter hardiness. Sheep left the stems as stubble to hold snow and by spring the stubble in ungrazed fields was nearly identical to that of the grazed fields. Fields with low-lying southern and eastern exposures were grazed earliest because they have the greatest chance of being drifted over in late winter. A second palpation and sorting of the dry flock in early November was necessary to detect late-lambing ewes because late fall, out-of-season lambing typically results in delayed udder development before lambing.

For the October 20 to November 20 breeding period, a single sire breeding was possible with 400 ewes since two thirds of dry ewes were already bred for the January lambing and, on a 5-acre or smaller paddock, the cycling ewes had no trouble finding the ram. Because 8 to 10 ewes were crowding the ram to be serviced in the latter half of the breeding period, the first ram was replaced. In most cases, very few ewes will be left to service in the latter half of the breeding period. The rams were generally easily caught on pasture at the end of the 30-day breeding period by offering them a bucket of grain or hooking them with a leg hook.

Beginning in 1998, we shortened the fall breeding season to 20 days. This allowed all ewes the chance to cycle at least once and, based upon previous records, more than 90% of the open ewes should breed during the first 20 days of breeding. We have since shortened all but the March-April and June breeding seasons to 20 days. This reduced the annual number of days lambing from 150 to 120 so that our labor could be used for other activities and still maintain high productivity.

In late November through December, the extended grazing season started out as one of the most difficult seasons with heavy snow in November and record cold in December (mean 14°F, while normal is 28°F). To a 4-inch base, 20 more inches of snow fell in December, but there was sufficient wind to keep the flat alfalfa fields open.

Near Christmas, all dry ewes were trailed back to the barn for pregnancy detection by udder palpation for the January lambing. At that time of the year, in addition to those with noticeable udder development, another 10% of the lowest condition scoring ewes (those below a condition score of 2) were kept in the barn and fed with the prepartum ewes 1 lb of 16% dairy supplement and free choice hay or hay-crop silage. All ewes developing an udder for the January lambing were sheared while those kept back due to low condition were left unshorn. The remainder of the flock returned to a permanent bluegrass pasture near the barn. The more open (windswept) bluegrass pasture was consumed within a week. To make for easier grazing during breeding and to meet the high nutrient requirements of ewes still left in the dry flock that would lamb in late January, the ewes were moved to a field with heavy regrowth (1 ton of dry matter per acre) of timothy and orchard grass.

During the second week of January, all pastured ewes were returned to the barn for a second udder palpation and an additional 25 ewes were identified for late January lambing. Of the 40 low-condition scoring ewes kept and fed in the barn, 25 were then obviously pregnant. Their thin condition just before Christmas was likely due to early use of nutrients for two or more developing lambs or because they were young ewes with their own growth as well as pregnancy requirements. The remainder of supplemented ewes that were not pregnant were returned to pasture with the dry flock in better condition for breeding if they were still open (some were be pregnant to lamb in the March-April season).

All pregnant ewes discovered in the second palpation to be pregnant for the January lambing were shorn and fed 1 pound of a 16% protein dairy supplement and hay-crop silage in preparation for lambing. Ewes that had lambed in the fall were not shorn before lambing since they need long wool for winter grazing. The moderate to low grease content of our Dorset and Finnsheep fleeces is well suited for shedding moisture and drying out in wet spells. Shearing off pasture

preceding each lambing of the January, March and May periods results in extremely clean fleeces.

The January weather was less cold and snowy than usual, but there was no major thaw so that the taller hay field aftermath could be grazed thoroughly. After the first major thaw in early February, we used shorter timothy regrowth in hay fields and bluegrass in the permanent pastures, which had been reserved for late winter grazing. These two grasses maintain their quality best into the spring. Orchard grass, with its heavy fall regrowth, is excellent through deep snow, but it forms a mat on the ground with the first major thaw and molds easily even before the snow is gone in the spring. Snow accumulation through February never exceeded 6 inches; therefore, shorter, late-cut timothy regrowth provided excellent grazing through February. The ewes were returned to the barn in early March to be palpated for the March 15 lambing and all remaining ewes due to lamb in May were shorn by shearing school participants so they remained inside until spring pastures were ready in mid-April. The 200 January-lambing ewes weaned from their lambs were returned to the bluegrass pastures for two weeks of grazing and finished all remaining pasture on March 19. Other years the permanent pastures have lasted up until the growing season. Seedings of rye planted in the chopped corn fields in early September have also been used to provide pasture in early April and carry over the grazing sheep until the permanent pastures are ready to graze. During the fall and winter grazing season, we fed bales of hay one day on pasture because blizzard conditions would not allow the sheep to graze.

Approximately 10 days throughout the winter at times when the ewes were being palpated for lambing, the dry ewes were kept in or near the barn sometimes being fed inside and other times grazing near the barn to avoid blizzard conditions. By grazing late summer and early fall in areas that would have been difficult to graze in mid-winter, we were able to keep the sheep out during storms with little risk of them being stranded. The improved reproductive performance of our Dorset and Finnsheep on the STAR System over the years has greatly increased the number of ewes available for fall and winter grazing. Their higher frequency of lambing results in a greater opportunity for profit from the high quality, inexpensive feed resources available in the fall and winter. Through our average winter of 70 to 80 inches of snow annually, success at winter grazing over the 17 years from 1983 through 2000 shows that most years there is the opportunity to substantially lower annual ewe feed costs for a STAR-lambing flock. The opportunity to use pastures of differing quality throughout the winter could actually result in higher productivity from the pastures at a lower annual ewe feed cost on the STAR System than a once a year winter lambing flock. The January lambing is by far the most expensive period to lamb ewes from the standpoint of feed and housing costs, but because our STAR ewes lamb in this period only once in three years or once in every 5 lambings, stored feed costs per ewe are greatly reduced.

In practice, housing for no more than half the ewe flock is required for a STAR lambing flock while an annual lambing of all ewes in the winter requires housing for the entire flock at one time. The STAR System's 5 annual lamb crops spread housing costs over 5 lambings, while during lactation at the 4 lambings other than in January the ewes can be released daily to graze and return each night to nurse their lambs. The shedding of lambs daily is practiced by other shepherds on pasture to provide lambs clean pasture, but we have not chosen to give up the many advantages of confinement rearing of market lambs and only pasture lambs being raised for replacement. The advantages of confinement rearing lambs include protection from heat, cold,

moisture, insects, parasites, and predators. One of the greatest advantages of raising lambs in confinement year-round is the high year-round market value of a young, fast-growing, lean lamb. This is so unique that dips in the national prices of market lambs have minimal effect on the price of STAR-produced lambs because we constantly have lambs of all sizes so that we can sell buyers exactly the size wanted throughout the year.

Guidelines & Trouble Shooting

1. Providing water on pasture is often a major concern because provision of fresh water always is a cardinal rule and little thought is ever given to natural sources of water such as the water in the forage itself. Moisture requirements at mean temperatures below 45°F for pregnant dry ewes is 2 parts water to 1 part dry matter for ewes up to the last 6 weeks of pregnancy and as high as 5 parts water to 1 part dry matter in late pregnancy. This means any forage above 83% moisture would meet all water requirements without any dew or snow. Water requirements at mean temperatures of 70°F can be nearly double the requirements at 45°F. By September in central New York, there is also abundant dew every morning to supplement early to mid-pregnant ewes on grazed forage. By October when some dry ewes are in late pregnancy, the mean temperature is below 50°F and precipitation and ground water is higher; therefore, the grazed forage is rarely below 83% moisture. From November through April, mean temperatures in Central New York are below 45°F and forage moisture alone is often above the highest requirement of 83% moisture. Water in forage and dew is likely cleaner than water in a trough in which rodents or birds sometimes drown themselves. Even at subfreezing temperatures, highly productive ruminants often have excessive metabolic heat from fermentation that can be balanced with moisture consumed in forage or as snow eaten with the grass with no cost to the sheep despite the consumed moisture having to be raised to the 103°F body temperature of the sheep. On the other hand, because of the volume consumed at one time, drinking water at 35 to 50°F will require calories to be heated at a cost to the sheep. Furthermore, an influx of cold water will reduce the temperature of the rumen and interfere with rumen fermentation. Forages with water contents of 70 to 90% also require little further hydration to be fermented while dry hay can take many hours of hydration in the rumen before being available for microbial action. Water in excess of 90% typically found in many brassicas grown for a fall forage crop are in excess of the animal's needs and requires heating and elimination. In the fall and winter, this excessive water will cause lips to chap; therefore, brassicas should be used early. This chapping is never encountered in sub-zero grazing of fall regrowth in hay fields or pastures.

2. The second most common obstacle to winter grazing is frozen soil and the difficulty in setting posts for temporary fence. In addition to preserving the feed value of the plant material, snow cover also provides excellent ground insulation and prevents deep penetration of frost; therefore, it has been our experience that during most of the winter the soil is not hard enough to prevent the planting or pulling of fiberglass posts by hand. Removing posts is usually a greater problem than placing them; therefore, when the ground is hard or is likely to be frozen before the next move, posts should not be placed deep into the soil. The metal ends of livestock netting are often the most difficult to remove. If not too deep, they will loosen up quickly with the least thaw or can be kicked at the surface and loosened in frozen ground. When setting up the fence, if posts are placed in a clump of grass, they will go in more easily. As a last resort, a 2-pound hammer with a piece of reinforcing rod will make a hole in any soil conditions such as a roadway or a

high point that has drifted open where the frost is deep. To secure the windbreak, we use 3 creosoted hardwood reusable posts or ¾-inch fiberglass posts and occasionally have to leave one or two behind until warmer weather. The PVC pipe in the windbreak is more brittle in sub-zero conditions. Therefore, if the pipe is frozen down it should be moved at the warmest time of the day.

3. Udder palpation as a means of pregnancy detection along with a red to pink color of the vulva on our white-faced sheep is usually 95% effective with one palpation just before a 30-day lambing period. Unfortunately, the October-November lambing period is the exception and the first palpation may detect only 70% of the ewes lambing in the subsequent 30-day period. Therefore, a second palpation 10 days to two weeks into the lambing period is required. Some years we have had in excess of 20 lambs born on pasture in November without a single loss, while other years as many as half the lambs born on pasture in November from ewes missed in the first palpation have died of exposure.

4. Cast ewes on pasture are sometimes a problem. The high gut fill on unlimited high quality fall pasture contributes to a ewe finding herself on her back and unable to turn over. Fortunately, in cooler weather, ewes can survive being on their back for many hours or overnight and can recover in a matter of minutes. To reduce a ewe's chances of turning over in the first place, sprinkling with an external parasite treatment helps to reduce the bite of external parasites and minimizes the chances of ewes getting on their backs while trying to scratch in the first place.

5. Supplementation on pasture. Free choice trace mineral sheep salt should be provided continuously so there is no crowding for salt. If weather conditions are severe enough to prohibit grazing, grass hay will be best utilized since most of the stems of alfalfa hay will often be refused because the grazing sheep's mouth is not toughened to coarse feed and the leaves of alfalfa are more likely to be lost to shattering. As on summer pasture, we would never recommend grain feeding during winter grazing. Fall aftermath is of such high quality and so inexpensive that feeding grain is not necessary or economical. If grain is used for flushing, it may have a negative effect in that ewes will wait for grain and not eat forage to appetite.

6. The order of grazing each pasture can make a lot of difference in length of time an extended grazing will last; especially if there are limited pasturing resources. The sooner alfalfa fields can be grazed after the first heavy frost, the better. After the first heavy frost, the alfalfa quits growing while permanent pastures and grassy hay fields continue growing at near peak production. Use the fields furthest or least accessible to the barn first. Graze in 3- to 4-day rotations to minimize trampling and soiling feed so that the flock is only cleaning up the last of the field for 12 hours or less and the remainder of the time the ewes are essentially on full feed. Graze areas on southern and eastern slopes that are prone to drifting earliest and leave western and northern slopes that will likely be blown open during the heaviest snow accumulation. If possible, start grazing at the bottom of a hill. On steep hills sheep have no problem grazing through 18 inches to 2 feet of snow. Broome and reed canary grass should be grazed earliest. Orchard grass will grow the latest into the fall and accumulate the heaviest dry matter; therefore, it should be kept for later grazing in midwinter when it is ideal for the deep snow conditions. Timothy and bluegrass will not stockpile as many tons per acre as orchard grass, but they will maintain their quality through mid-winter thaws and can be grazed more successfully if spring

snow depths are moderate. The weather is the greatest variable, but the short-term cycles often have some predictability. The strategy that works best is to try to have the sheep finish a rotation near the end of warm calm weather and move them to a new paddock just before a cooler, less settled cycle starts. In snow-covered fields, if pawing has opened up the entire area, it is time to move to a new rotation. Otherwise, judging the time to move by the fill of the sheep works well because as long as there is good high quality feed, they will keep full.

On the other hand, since the ewes on winter pasture are not lactating, they do not require a full stomach at all times for optimal productivity. Therefore, if grazing is limited due to weather conditions for 12 hours or less and they had a chance to fill up before bad weather set in, they will be able to weather most storms behind the Netlon wind break without supplemental hay. In late gestation, ewes with well-developed udders will often not be able to bed down on the snow and will stand up behind the windbreak to stay warm and prevent frostbite of the udder. The flock should be brought to the barn to be sorted for pregnancy when this happens and those not pregnant for the next lambing period returned to pasture.

7. Labor of moving the fence for 400 sheep requires 6 to 8 hours weekly if adjoining paddocks are used; 8 to 12 hours if the flock is being moved to other fields. Livestock netting is used to corral the sheep while the quick fence is moved. The windbreak with 6 sections will fold up and weighs less than 75 pounds; therefore, it can be carried easily. The sheep have to be acclimated to the Netlon windbreak before serious storms. One of the best ways is to feed salt right next to the windbreak. Before the first storms, put a few bales of your best hay inside the windbreak. Check in the early stages of a storm and, if the sheep are not behind the Netlon, lead them close with a bucket of grain and keep their interest by feeding the bales of hay.

8. Because winter pasture is not growing, ½ to 1 acre per sheep of winter pasture is required for 4 months of grazing. The use of unfenced hay fields means that the winter grazing sheep will come in more contact with wild life. Hawks, owls and foxes find small rodents are easy prey when uncovered by sheep pawing through the snow and sometimes these other animals will feed among the sheep but they are no problem to the sheep. Deer and coyotes are of more concern. We have only confirmed the loss of one sheep to coyotes, while some years we lose one or two sheep to a parasite (Parelphostrongylus) carried by deer that invades the spinal cord of sheep and causes partial to complete paralysis of the back half of the sheep.

9. The feed analyses in Table 1 show that winter grazed forages are consistently higher in protein and energy than required by even late-gestating ewes. This results in twins weighing 7 to 12 pounds at birth from 160-pound ewes. We credit the ewes ease in delivering these large lambs to their excellent physical condition from grazing through the snow. Dystocia in single births is much more of a concern and yet rarely does the mortality from birth to weaning exceed 10% despite no night checks from 11 PM to 7 AM. The stockpiled fall regrowth is best suited for ewes carrying triplets and preparing them to raise triplets. Because triplet-bearing ewes give the greatest return and triplets are the most common litter size in the winter and spring lambings of our accelerated Finn × Dorset ewes, forage winter in winter pastures comes closer to the ideal feed than most conserved feeds. It is also hard to beat a monthly feed cost of 45 cents per head for winter pasturing ewes.

Portable Windbreak for Winter Grazing

This portable lightweight (75-pound) windbreak is a major component of our winter grazing program. The circular, six panel, 40-foot long windbreak pictured has provided shelter for as many as 400 pregnant ewes through an entire winter. Ewes in these large flocks will line up on the leeward side of the windbreak eight to 10 sheep wide stretched out as much as 200 feet long. No matter how strong the wind, they never crowd or pile on top of each other, as they will if crowded against a fence with no wind protection. Drifting snow first piles up in the center of the windbreak and, after filling the center, additional snow will either go around or over the top leaving the sheep well protected. The Netlon windbreak serves its greatest function by protecting the sheep through the worst weather conditions, so that when the wind subsides, the sheep are right out in the windswept parts of the pasture where the forage has the least snow cover in mid to late winter. By contrast, areas with natural windbreaks usually are more heavily snow covered after blizzard conditions. Such areas are grazed earlier in the season.

The windbreak is secured with four 5-foot by 1-inch fiberglass posts. The secured windbreak is located within a paddock in such a way that the sheltered sheep will not come in contact with the fence no matter which way the wind blows. Fiberglass posts minimize wear from rubbing the Netlon and are most easily pulled from frozen soil. Manure buildup is never excessive because the wind rarely blows from the same direction and because the sheep are moved to new paddocks at intervals of a week or less.

Materials and construction. A windbreak with six or seven panels is recommended for a flock of 500 ewes or less. Forty feet of one meter wide Netlon is required for the six-panel unit. Six pieces of 20 foot by one inch schedule 80 PVC tubing are each cut into two 3-½ foot and two 6 ½ foot lengths to form the frames which are connected with four elbows per panel. Before gluing the frames, each 3-½ foot end is first woven into the Netlon at 18-hole intervals. The 6-½ foot pieces are then connected on the top and bottom with the four elbows. For nonplumbers – be generous to the point of even sloppy with the glue making sure to first coat all surfaces making contact before connecting each elbow. A six or seven panel unit will fold flat in an accordion pattern with the Netlon alone hinging each panel together. With each end tied together, the windbreak is easily moved by balancing it lengthwise over one's back or, for long hauls, in the back of a pickup. The total material cost including fiberglass posts to secure the windbreak in the field is less than $150. The payback is almost instantaneous with 400 pregnant ewes – the opportunity to continue winter grazing saves better than $50 daily in feed costs over the feeding of hay or silage of equal nutritional value. The first windbreak we built is five years old and shows little wear except for being faded