MACHINERY FOR SILAGE MAKING, STORAGE AND FEEDING OUT

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EVOLUTION OF A CONTRACTING BUSINESS

When I began work in my father's agricultural contracting business around 20 years ago, the operation had three peak periods. Crops were sown in September/October, hay was baled in December and pasture was resown in March after cash cropping. The business had relied upon seasonal labour and as I was interested in developing the contracting to a stage where we could employ permanent staff, we decided to expand into silage and grain harvesting to increase the length of the working season.

The grain harvesting was straightforward and presented no problems, but the silage harvesting operations were slow to develop because at that time the accepted method of making silage in New Zealand was to use a flail type forage harvester and direct cut. This resulted in low quality feed which was often sour and unpalatable. We soon found that letting the grass mature past its peak stage before harvesting improved its palatability to stock, although its feeding value was lowered. However, farmers quickly built up a resistance to feeding out this type of material as it was too long to handle mechanically and had to be cut out of the stacks with axes, hay knives etc. and then forked onto and off the trailer. After two or three years of trying to promote this system we purchased a double chop machine which, while still direct cutting standing crops, reduced the length of the material sufficiently to allow it to be fed out mechanically.

Right back at the stage of the first straight flail machine we attempted to introduce maize for silage because we were interested in creating work in the autumn (April). The double chop system quickly took on for grass silage, but while we made some progress with maize, it was not until we purchased a precision cut forage harvester in 1968 that maize for silage really caught on in the Wairarapa.

The contracting company expanded through the 1960s until in 1970 it reached a peak where we employed six full time staff and up to nine or ten casual helpers through the season. By this stage the operation was large enough to run big specialized equipment and we found that when quoting on jobs we were often far lower than our competitors yet still maintained satisfactory profit margins. A good example of high capacity equipment being able to hold and reduce costs would be our pasture silage operation. When we started with the straight flail type harvester it was costing the same to harvest a crop in the form of silage as it did for hay; the only advantages being that there was less weather risk and the pasture could be harvested earlier. Today, using a 120 hp tractor and a heavy duty high capacity forage harvester, the silage harvesting costs are reduced to 50% of the cost of making hay.

In the early 1960s we started to retail farm machinery in the Wairarapa valley as well as running the contracting operation. Later, when we could see the huge potential that was going to open up for equipment to produce and feed out high DM fine chop silage, we made arrangements to import this type of machinery. This side of the business has made real progress over the last few years and as the contracting plant had reached the stage where it needed re-equipping and finance was not available for this without curtailing the growth of machinery marketing, we sold the contracting company off to three different operators. Labour problems also contributed to this decision.

When sold, our contracting equipment consisted of a 120 hp tractor and a heavy duty large capacity forage harvester. With this equipment we averaged between 400 - 480 hectares of grass silage and 80 - 120 hectares of maize annually. This was more than adequate to give a satisfactory return on the captial invested in the equipment. However, only 50% of the tractor's overheads were charged against the silage account as the tractor was used for cultivation work as well. If a contractor is equipping solely for the purpose of making silage and has no other use for a high hp tractor, it is more economical to engine power the forage harvester and then tow the harvester with a light farm tractor. However, in most districts there is a demand for high hp tractors for cultivation work.

In the mid 1950s, when we started making silage using a straight flail type forage harvester, we worked this machine in conjunction with two trucks using a tractor and buckrake to build the stack. This four-man team harvested 3.5-4 ha/day of grass silage. Later, when we purchased a 2 m double chop machine and a higher hp tractor, the same four-man team averaged 7.5 ha/day. In 1968, we changed to a precision cut forage harvester and an 100 hp tractor plus a 3 m mower conditioner for cutting and windrowing; and with this gear and a five-man team we harvested 12 ha/day. With the same equipment, but an 120 hp tractor, we increased our capacity to 14 - 16 ha/day in 1972. The wilting and fine chopping reduced both the weight and volume of silage harvested, thus allowing two trucks to handle over twice the area per day that was possible using the double chop machine. This saving in the cartage more than offset the additional cost of having to cut ahead to wilt the pasture and reduced the cost/ha. In addition, the equipment had a second season because the maize area increased once the correct harvesting equipment was available.

Last year in the Wairarapa the average cost of cutting, raking, conditioning, baling and carting a bale of hay into the shed was in excess of 50¢/bale. A hay crop of 200 bales/ha would therefore cost around $100/ha to harvest, whereas silage contractors using the large cut and blow type forage harvesters averaged less than half this figure. In addition, silage suffered less weather damage at harvest and gave a higher feeding value than hay. Time is saved at feeding out by using a self-unloading forage wagon. While the forage wagon can cost between $3000 - $4500 depending upon the size, they have a long life and on most larger farms will pay for themselves in the time

saved in feeding out. It is already becoming a common practice among the small farmers for two or more farmers to work together with one owning the forage wagon and feeding out for his neighbour on a contract basis.

MAIZE FOR SILAGE

In the past some farmers attempted to make silage from maize grown in 15 cm drill rows sown at between 45 - 65 kg seed/ha and harvested with a flail type chopper. The wet, sour, poorly packed silage which frequently resulted from this put farmers off maize as a silage crop. Yet overseas, maize is one of the major crops grown specifically for silage.

There are at least three reasons for maize silage popularity overseas, namely:

— maize silage is simple and reliable to make provided proper equipment is available;
— yield of digestible nutrients per hectare is high;
— maize can be made into silage any time over a period of several weeks provided fineness of chop can be used to compensate for crop dry matter.

Maize must be fine chopped to permit good packing in the stack and good digestion of gain. Length of chop becomes even more crucial when very mature, dry crops are ensiled. Current U.S. recommendations are to take maize to the late dent or glaze stage (approx. 35-40% DM) and chop to 6 mm lengths for storage in gas tight silos. Under New Zealand conditions where trench type silos are mainly used we have found that it is better to harvest at a lower dry matter content of approximately 30%, making silage which is less permeable to air and thus avoiding wastage through oxidation. At this moisture content (70%) kernels are at the mid-dent stage and are soft so the cutting length can be longer (12 mm). In the Wairarapa, the farmers who have been making maize silage in this manner are in the main very satisfied with the results they are obtaining. However, they all report that they find some kernels passing through the animal which apparently have not been fully digested. If, for example, 10% of kernels did pass through animals undigested, this would account for approximately 8% of crop TDN or loss of $26/hectare of harvested crop if that crop cost $220/hectare to grow and $110/hectare to harvest using contractors. This type of cost needs to be balanced against the power/time cost of finer chopping.

An average maize crop yielding 8000-9000 kg grain/ha at 30% DM cut at 1.2 cm length using 140 hp tractor and heavy duty type forage harvester with sharp knives would cost approximately $93/ha to harvest, cart and stack in a bunker. However, if a 90 hp tractor was used with a medium size forage harvester, the cost would be approximately $110/ha. If the crop was slightly more mature with a dry matter content of 35-40% and the length of cut was reduced to 6 mm it would cost approximately 10-15% more. These charges are based on last year's contractors rates.

While the small single row forage harvester would be uneconomic for a contractor to use, they are very satisfactory where a farmer is growing a small area which he intends harvesting himself. These single row machines are designed to work with tractors from 35-90 hp and work very satisfactorily on the average farm size tractor of around 50 hp. Now that maize is being grown on many farms for silage we are seeing a trend towards green feeding part of the crop in the early autumn and these small machines are very suitable for chopping and loading a forage wagon for this purpose.

It can be seen that good machinery is required to make quality maize silage. However, the initial cost of setting up is obviously a deterrent, particularly where a contractor service is not available. Fortunately the larger forage harvester can be equipped for both maize and wilted grass silage and since these crops are harvested at different seasons this gives good utilization of the machinery.

Wilted fine chop pasture has several advantages in its own right, namely:

In comparison with hay
— lower cost, approximately 50% lower into storage,
— making and feeding out are easier to mechanize,
— better quality since it is made from less mature pasture,
— less dependent on weather,
— better pasture recovery in early summer.

In comparison with direct cut, long-chop silage
— intake and quality better because acid stabilization occurs at a higher pH,
— feed-out can be mechanized and material is pleasant to handle,
— better for self feeding,
— cartage costs are lower on DM basis,
— no pollution from run-off.

Wilted pasture silage made at the correct stage of growth is high in protein and should provide a good nutritive balance when fed with maize silage.

STORAGE OF SILAGE

While the direct cut longer material can be stored in stacks built on top of the ground, this system is dangerous and has resulted in a lot of fatalities over the years. This system also resulted in a high degree of wastage. However, once pasture silage is wilted or maize silage is matured down to 30-35% DM and fine chopped, it is essential that it be stored in either a pit dug into the ground or a bunker built on top. The lower the moisture content, the shorter the cut must be in order to gain satisfactory consolidation and the better the stack needs to be sealed. Most farmers today cover their stacks with polythene and weight them down with materials such as lime, soil, car tyres etc. However, with wilted pasture silage there are still a few who will leave a small area with which they harvest without wilting so as to put a layer of material 15 cm deep over the top of their stack, relying on this high moisture to form a seal. However, this can be risky because once air penetrates this top layer, considerable wastage can be suffered through overheating.

The lower the moisture content the more important it is to make a good job of covering the stack to keep air out. The sides of a pit or bunker should be at least 30 cm higher than the final silage level, so that the plastic film can be laid down the side, across the top of the stack and up the other side. Lime that is used for weight can then be added to a depth of 5 cm so that as the stack settles the plastic film will follow the stack down and the weight of the lime will continue to give a reasonable seal against the sides of the pit or bunker.

If a crop is over mature or grass has been over wilted, shortening the cut and good covering of the stack can still produce good silage. However, if adequate provision is not made to obtain a seal, the silage will over heat and become useless.

Most large scale operations dump the chopped silage in front of the bunker and use a tractor with a buckrake or front-end loader to push the material in. This is an ideal system because during filling the tractor assists with consolidation.

In the United States there are more and more silos being erected, both concrete and steel with glass lining. The steel types with glass lining are claimed to be completely air tight. The tendency has been for these silos to get higher with more of them being over 30 m high. Because of the height, this system of storing silage gives excellent consolidation and allows for fully mechanized feeding systems with both top and bottom silo unloaders discharging onto conveyers which take the silage directly to the stock. The capital cost of this system of storage puts it out of the reach of the average New Zealand farmer.

FEEDING OUT

There are two main methods of feeding high dry matter finely chopped silage in New Zealand, namely:

— self feeding, and

— feeding out using self-unloading forage wagons.

Self feeding: A wide range of methods have been tried and are being used for self feeding. Where silage is being used as drought protection and is being fed under dry conditions, it is quite common just to let the stock eat their way in from the end of the stack using only an electric fence to stop them climbing on the stack. However, this system is wasteful and if it is used under winter conditions it usually results in colossal wastage. In the last two or three years a number of farmers have built a concrete base on which to build their stack and on which the cattle stand when self feeding. A concrete base coupled with frames that are built strong enough so that the cattle cannot move them gives the best control. The best self feeding platform that I know is on Mr Hamish Buchanan's property at Gladstone. He has built a concrete base and a frame made out of railway iron which he shifts up against the stack face with a tractor two or three times a week as required. This method of control results in practically no wastage, as he can leave the frame in position until the cattle have cleaned the silage right down to the concrete before shifting the frame back against the stack face. Self feeding is best suited for dry stock as it does not encourage maximum intake, but it has the disadvantage of not allowing different feeds to be mixed.

Forage wagons: There are three main methods of digging silage out of a bunker. The most popular is a front-end loader equipped with a suitable fork. As most farms have other uses for a front-loader and because these loaders have a high capacity, this system will continue to be the most popular in the foreseeable future. However, as the front-end loader has a tendency to loosen more of the face than is really necessary, deterioration of the silage at the stack face will take place. Providing the face is not too large in comparison to the amount being fed this is not normally too serious. In large scale operations, a silo unloader which cuts a clean face can be justified. These machines cut a strip off the face and because of the action of the cutting knives, leave a smooth surface which is difficult for the air to penetrate, thus reducing wastage. However, they are not as fast as a front-end loader and the larger models which have a high capacity are expensive, costing between $9000 - $10000. The third method is to use a slew loader with a grab. This is slower than the front-end loader, but has the advantage that it is a stationary unit and does not make mud or cut up the ground around the silage bunker. This unit has no real advantage over the front-end loader once a concrete floor is put into a bunker.

Once the silage is dug out of the bunker and loaded into the self-unloading forage wagon, the wagon can either discharge the silage directly back onto the paddock or fill feed bins or troughs. When a farmer has the feeding out operation mechanized we are likely to see far more feeding bins and troughs in use as this can save considerable feed and result in higher profits. The forage wagon has the advantage that feed can be transported around the farm where required and allows feed to be mixed, e.g. maize and pasture silage can be fed by putting a layer of each into the wagon. Additives such as urea, meat meal or minerals can also be blended reasonably well with the feed if spread on top of the load.

CONCLUSIONS

High dry matter fine-chop silages made from pasture and from maize fit well into a contractor's operation. Large scale contracting gear can put this type of conserved feed into storage at a substantially lower cost than hay. Reasonable cost self-feed and semi-mechanized feeding systems are available to reduce labour inputs at feeding out and so make a system attractive to many farmers.