

Maize cobs are now 50 times bigger than the oldest fossilised remains found from 6,000 years ago in USA.

Maize is an incredibly fast growing and high yielding annual grass species with high sugar and energy levels, but low protein and lower feed value than clover based pasture. The best grain hybrids yield up to 12,000 kg per ha (10,800 lb per acre) of 17% moisture grain in six to seven months or 33,000 kg of silage dry matter per ha (29,440 lb per acre) in five months, as show here. Sowing was 100,000 per hectare. Note the green stems and leaves right to the bottom, showing that it was well fed with lime and complete fertiliser. It was 4.2 m (14 ft) high and I was 1.7 m.

The average grain yield in New Zealand is about 7,000 kg per hectare, Belgium 9,000, UK 7,000. Zimbabwe when Rhodesia, was 8,000 and now is about 800 (not a typo). The best in South Africa is above 10,000 kg. The price to NZ growers is about NZ\$500 per 1,000 kg. To achieve this yield requires perfection, seldom seen.

The best maize silage crops can yield nearly double the annual yield of average pasture, but with nowhere near the feed value, digestibility, or mineral levels of clover based pasture, but maize is a good feed when fed at 30% with 70% lush pasture.

New Zealand had the world's highest average yield of maize grain per hectare in 1995 and most probably in many other years, thanks to a kind climate and high value land, that



has to be well fed to get a return on its value of about NZ\$40,000 (US\$30,000) per hectare or US\$12,000 per acre.

Some maize yields in the Waikato and much of New Zealand in the 2007/8 season were the worst in living memory because of a cold, wet, late spring, followed by very little rain in December and almost none in January and February, and not much until mid April. However, where everything was done correctly, crops were not as bad as most.

In 2010/11 90,000 seeds/ha sown per hectare were the best, especially in the size of cob, which is the main feed value. 120,000 seeds/ha were the worst. This is not 100% accurate because they were not on identical paddocks or areas.

In the three drier summers up to 2015, 80,000 seeds/ha yielded more than 100 seeds/ha.

The maize above was being ensiled, at the stage it should be, before it gets too dry and kernels are too hard. Dry kernels have to be cut (knicked) when harvested. These in this cow dung were, but harvested too late, so as can be seen, were not digested, making the maize silage of low



feed value and half the feed value of optimum maize silage. The pasture grazed at the same time was too short and lush, creating a double problem or fast travel through the cow, so poorer digestion.

Sodium is the first digestive juice. It and a soluble mineral mix were not being fed, so both, resulted in less

saliva.

No salt means less saliva which means poor digestion of whatever is fed. Hay or long pasture help, but both are rare in today's over-stocked farms. So goodness was lost. It was from a well stacked maize of precision cut which is bad news, unless you are in the northern hemisphere and have a tower silo which needs it cut short to blow it up into the tower silo, which is why the fine cut system was developed - not for feeding on pasture. Many tower silos in USA, and all six built in the Waikato, are now unused because of the cost of operating them and the bad silage made, because it can't be compacted and is too short for animals to regurgitate.

For good silage help the maize harvester operator remove every second blade so that your silage is cut long enough to reduce waste when feeding on pasture, and can be regurgitated, chewed and digested completely, without kernels (profit) going out in the dung which I see on many contractor late-harvested, fine cut silages, and never saw on flail harvested maize silage correctly cut at the correct time.

If harvested late it also makes the subsequent autumn pasture sowing late. Read Silage & Hay.

Most Waikato maize crops for silage that I saw on 28 February 2011 needed harvesting then, but many would not be done for months because of overloaded contractors. The base was going brown showing that the crop would have benefited from more lime-plus and/or fertiliser and that it is getting lower in feed value every day, so should be harvested.

Most farmers end up harvesting too late and blame the contractor, but they can't do all crops on one day. Book your contractor now to harvest yours next year when required, or you may have to wait a month, so your maize can become over mature and the kernels can be so hard that they go through the animal as shown above. Also green has more protein than brown, and maize needs more protein.

Linda Scrace's green, still growing maize shown by their son-in-law Mark in April 2011. Linda wrote, "We used Vaughan's lime and fertiliser recommendations on our Mangonui gum soil, north of Kerikeri and the yield was good, with large fully filled cobs."

The variety is Hycorn 624 from Pacific Seeds at 80,000 plants per hectare. Independent trials over several sites, showed the yield was better when planted at 80,000 compared with 90,000. In dry countries much lower numbers per hectare are sown.

120,000 plants per hectare on a much more fertile Walton, Waikato, volcanic soil, had smaller cobs and a 20% lower yield than the above, which was on a poorer Northland gum soil. The 120,000 crop started well because it had 300 kg per hectare of DAP wrongly recommended by the contractor, drilled in at planting which is much too much in a concentrated area which is always bad, so the roots went to it instead of going down, so when dry weather came in the last few months before harvesting, growth stopped and the crop dried up.

This photo shows our maize with long deep roots going down 40 cm and yielding 30 tonnes per hectare of silage dry matter. Correct Lime and fertiliser were chisel ploughed in separately, with no side dressed DAP. The middle roots were on a maize growing company's, shallow cultivated without enough lime. It yielded 18 tonnes per hectare of silage dry matter. The right maize was also shallowly cultivated on our old farm sold in 1987 when we were getting 30 tonnes. Its yield was 12 tonnes. Both had DAP side dressed around the roots which



encourages shallow rooting, so when summer dry weather comes, growth stops. Even in a perfect summer, chisel ploughing and correct LimeMagPlus and no side dressing, yields 50% more. All the above were in the 2013/4 season.

The shallow cultivated maize plants were pulled out with one hand.

The fork had to be used to get the other one out. All the above were in the Waikato in the 2013/4 season.

Measuring the yields of maize silage

The feed value is in the kernels, so dry and weigh the cobs per plant, as well as the whole plant. A tall plant with one cob has less total feed value than a shorter plant with three cobs.

Maize in some areas is a high risk crop (bird, pest and occasional summer frost damage), its feed value is low, and it takes five or six months to grow, so, if pasture is to be sown in autumn, maize can make sowing late, or impossible because of wet weather in some soils. Where necessary, Millets and Nutrifed avoid this maize problem.

Maize has varieties especially for silage, and fast maturing ones for short summer climates and early harvesting, to sow autumn pasture in good time. Some silage hybrids have soft textured kernels, and thin rind low-lignin stalks that break down in the rumen.

Some farmers have given up growing maize for silage because of the high costs of buying and owning machinery and operating it, and, even if using contractors, the cost of machinery and labour feeding it.

Do all the figures for ten years ahead before deciding on making maize or any other crop silage. Remember pasture silage is already available, and is far better feed value than maize or any crop. Cows milk well on pasture silage, they don't on maize silage unless fed pasture or pasture silage with it.

If renewing pasture is a main reason for growing a crop, then pasture to pasture could be better, but do a good job of it by spreading effluent (animal manure) on the paddock and adequate agricultural lime, and chisel plough it in. See Cultivation.

Many have gone into crop silage and gone out again, so beware. A USA farmer who changed from growing maize for silage to pasture saved US\$18,000 a year and produced more milk from the pasture silage. Beware of tradition, peer pressure and maize seed sales people. If growing it just for the carbohydrates or energy, feeding molasses in lick tubes in the farm dairy may be more profitable.

Harvesting maize for silage

If harvested too young, the silage will be low in sugars, be too high in moisture for optimum animal production and cause seepage which must not enter waterways.

The base going brown in maize crops for silage shows it would have benefited from more lime and or fertiliser and that it is getting lower in feed value every day, so should be harvested.

Most maize for silage is harvested too late because contractors are mostly running late. Book your contractor well in advance (and book next year's or you may have to wait a month) so your maize doesn't get over mature. If over-mature it becomes difficult to consolidate in the stack, so is more inclined to grow mould, both during the making and on the face when feeding, irrespective of how finely it is cut. If it is too dry then, add through a dispenser on the harvester, or sprinkle, whey, molasses or even water, if nothing better is available, to increase the moisture content. Also use a mould inhibitor, but preferably harvest earlier.

The main reason for growing maize on a pasture farm is to regrass the paddock, so this is another reason for harvesting the maize in good time, to get good autumn new grass establishment.

Aim for harvesting at 35% dry matter (65% moisture) for all except tower silos, which may require it to be drier to enable blowing up and eliminate seepage through the previously made silage. Dry matter can be measured as previously described. Take as much as possible of the whole plant to get an accurate figure.

Maize silage should be as close as possible to pH 4.

Harvest after a few days of sunshine, and after at least six hours of strong sunshine on the day of harvest to ensure high sugar levels.

USA type tower silage has to be drier and finer to blow up the tube and to avoid seepage down through previously harvested silage, so with corn it meant later harvesting. For these reasons recommendations in the UK and USA used to be for very fine cut, as short as 10 mm, but have now changed to 50 mm (2 inches) or longer because animal digestion and health were suffering, with low production and displaced abomassums. In 2009 I read that the Japanese now recommend silage be cut no shorter than 75 mm (3 inches).

Unfortunately this information has not been publicised in NZ. Many tower silos in USA, and all six in the Waikato, are now unused because of the cost of operating them and the bad silage made, because it can't be

compacted and is too short for animals to regurgitate and chew. When pasture grazed at the same time is short and lush this is a double problem.

For stack silage help the maize harvester operator remove every second blade so that your silage is cut long enough to reduce waste when feeding on pasture, and be regurgitated, chewed and digested completely, without kernels going out in the dung seen above.

Precision-chopping maize silage was developed and promoted because all knew that when the kernels pass through the animal whole, without being digested, most of the feed value of the maize is wasted. The solution is to harvest at the correct stage, before it gets too dry and hard. Also longer cut silage is chewed more and regurgitated more often, so the animal crushes (chews) the kernels at no cost to farmers and with many benefits. Salt and a soluble mineral mix should also be fed. No salt means less saliva which means poor digestion of whatever is fed. Hay or long pasture help, but both are rare in today's over-stocked farms.

Chewing makes saliva which helps to regulate the rumen pH, improves digestion and reduces the chances of acidosis.

A vet who wrote for USA Hoard's Dairyman magazine repeatedly told readers that all forage must be long to encourage chewing before swallowing, and to allow regurgitation.

The following are from Googling "fine-cut silage + regurgitation". Most is from USA.

New Zealand's lush pasture is a low fibre diet.

A lot of the silage referred to is maize (corn).

1. Milk fat content increased when longer cut silage was fed to cows receiving low fibre diets.
2. Milk fat tended to be higher when coarse, rather than fine silage was fed.
3. As expected, milk fat content was substantially higher for cows fed adequate forage fibre diets than for those fed low fibre diets.
4. Increasing silage chop length in diets of minimum forage fibre was beneficial for milk production.
5. Increasing silage chop length effectively enhanced milk production in diets lacking forage fibre.
6. In diets with adequate fibre, Journal of Dairy Science Vol. 77, No. 5, 1994 from forage. Increasing silage particle length effectively increased fat content of milk, but at the expense of dry matter intake and milk production. [This was an exception. The overall quality could have been low, and/or the low fibre could have of poor quality. Pastures outside of New Zealand seldom have much or any clover and are about ME 8. Many are 8.
7. Addition of a small amount of hay to low forage fibre diets was less effective than increased particle length of silage. Thus, in diets formulated to contain adequate forage fibre, increasing silage chop length may decrease animal production.
8. As expected, cows fed the adequate fibre diets cudded for longer than cows on the low fibre diets of lush pasture.

Despite all this, few do any of the recommendations.

The large number kernels not digested can be seen.

Chopping silage too finely causes waste through the whole system from wasted fuel, wasted time (it is slower), waste when feeding on pasture, poorer digestion when it can't be regurgitated, and reduced animal production.

With a flail harvester, which lacerates without cutting it too short the kernels don't have to be cut to be digested because the length requires more chewing before swallowing and regurgitating up to five times, all of which chews the kernels.

New Zealand's flail type foragers that he helped develop, and Buckton and Henry silage wagons have been copied and made in USA.

They have not been made in New Zealand since about 1990 because most silage here is made by contractors with big tractors and big northern hemisphere made harvesters that chop it short for blowing up into tower silos in North America which make low quality silage that is hard to regurgitate to chew.

Harvesting maize with a flail forage harvester is done by rolling the standing maize in one direction with a light tractor and Cambridge or V ring roller, then harvesting it in the opposite direction. The roller knocks off surplus moisture, allows the sun to shine on more of the plant, which raises the sugar level. The forage harvester then lifts the plant and cobs with almost no loss. A good lacerating knife and sharp flails must be used, to lacerate the crop thoroughly for good compaction. To avoid lifting soil and ensure a smooth surface, after sowing roll the paddock with a Cambridge or similar roller.

If using a rotating knife USA harvester, remove every second knife to cut it longer, which will reduce the waste that occurs when feeding fine-cut silage on pasture, and will improve its digestion. The harvester can then

travel faster, reducing the cost of harvesting and improving the feed value of the silage.

If a higher feed value silage is required for meat or milk production, cut it high so that more of the base of the plant is left behind, so the proportion of stem to cobs decreases. Maize which has had a frost should be also be cut high, because after frosting the nitrate level increases from the roots upwards.

If maize is frosted before harvesting, but still high in moisture, wait a week or more until dry matter levels are closer to optimum. The frosted dry leaves may fall, making better quality silage.

If possible, harvest sufficient green grass to put a layer over the top of the maize, because it packs down much better, and excludes the air more effectively. The pasture is also softer on the plastic cover, so less likely to puncture it.

Rats and birds love maize in all forms so should be controlled with poison. The white strip idea which rats are said to not cross won't work once you start feeding it and break the line. Birds will remember the black plastic covers from year to year and attack it soon after it is applied, allowing water and air to penetrate, causing extensive waste. Small bird netting may have to be placed over the tyres and kept taut, although large birds will press it down and still get through with their beaks. Two staggered layers of tyres under the netting will help.

Feeding maize (corn) silage

Maize silage on its own is low in minerals, so is far from a complete food. See the Pasture Mineral Analysis spreadsheet for the whole maize plant and others in columns A to X.

The following are grain mineral analyses.

Good pasture (75% grass and 25% clover) silage fed with 25% maize silage makes a good feed and increases milk and meat production. Don't feed more than 50% of the ration as maize silage because of its low mineral content and because it lowers animal Niacin uptake. Niacin (vitamin B3) can be supplemented at 6 g per

Table 2. Mineral content of major feed grains (NRC, 1996).

	Corn	Barley	Wheat	Oats	Sorghum
Calcium, %	0.03	0.05	0.05	0.01	0.04
Phosphorus, %	0.32	0.35	0.44	0.41	0.34
Potassium, %	0.44	0.57	0.40	0.51	0.44
Magnesium, %	0.12	0.12	0.13	0.16	0.17
Sodium, %	0.01	0.01	0.01	0.02	0.01
Sulfur, %	0.11	0.15	0.14	0.21	0.14
Copper, ppm	2.5	5.3	6.5	8.6	4.7
Iron, ppm	54.5	59.5	45.1	94.1	80.8
Manganese, ppm	7.9	18.3	36.6	40.3	15.4
Selenium, ppm	0.14	-	0.05	0.24	0.46
Zinc, ppm	24.2	13.0	38.1	40.8	0.99
Cobalt, ppm	-	0.35	-	0.06	-
Molybdenum, ppm	0.60	1.16	0.12	1.70	-

cow per day if before calving or during high production.

When feeding maize silage (or as green feed) with pasture increase DeLaval Feedtech soluble mineral mix in the drinking water from 0.006% of live weight when on correctly fertilised pasture, to 0.008% for cattle and less for horses and sheep. It is best administered through the drinking water, otherwise sprinkle it over the silage before feeding out. Salt is mixed in by some when making maize silage, even so, mixing evenly is impossible so I've seen the maize silage with salt being eaten and without not eaten.

Maize silage fed in spring helps reduce the ill effects of very high protein pasture, which is not well digested when energy levels are low because of little sunshine and high nitrates (indigestible protein). Excess protein can lead to high blood urea levels and low conception rates. Applying nitrogen increases this problem.

When feeding at high levels, rumen sweeteners like bicarbonate of soda should be fed to counter the acidity in maize silage. It can be of benefit when feeding large amounts of low pH pasture silage.

Diamond V Yeast spread over or mixed with maize silage aids digestion and has increased milk production

by more than its cost in New Zealand, but has not done so with good grazed pasture or pasture silage.

Yields

In 1992/93 the maize photo at the top was grown to my liming, fertilising and cultivating specifications by the late Bill Chynoweth on his Pukeroro Stud farm south of Hamilton in the Waikato, for silage, yielded 33,000 kg of dry matter per ha (29,440 lb of DM per acre) worth NZ\$0.40 per kg of DM which is NZ\$13,200 per ha (US\$5,300 per a). The height was 3.4 metres (12'4"). I'm 1.7 m (5' 7") and couldn't reach the top cob on this plant. The paddock had been in grazed pasture for about 25 years and got some dairy cow effluent by tank in most years. Growing maize on dairy farms' effluent paddocks is a good practise because it lowers the usually high potassium level. Client Bill Chynoweth followed my instructions of applying 8,000 kg per ha of Rorison's LimeMag (97% calcium carbonate and 0.175% Mg), chip hoeing it just deeply enough to kill the pasture, chisel ploughing it once and then applying 1,000 kg per ha of the best reactive phosphate (RP) containing 13% of 38% citric soluble P equals 130 kg of P, serpentine and deficient elements. 122 kg of P will be removed in the 33,000 kg per hectare crop. I based elements needed on pasture analyses. It was chisel ploughed in twice in different directions (See Cultivation).

The fertiliser mix included 50 kg of Durasul 100% elemental sulphur, 25 kg of Ulexite containing 11% boron and 1 kg of fast release selenium chips containing 1% Se (for animal health) all per ha (multiply by 0.9 for lb per a) and 2 litres of N-Fix per hectare, now called Tri-Fix, sprayed on before sowing.

The adequate lime and fertiliser provided enough for some plants to grow three cobs per plant and be green and growing right down to the ground until harvesting. This is important to help achieve high quality silage. Some set the cutter higher to leave more of the dead dry, brown stem behind, which lowers the feed value. It is better to feed the maize more lime and correct fertiliser to avoid this.

Bill Chynoweth, Pukeroro, Maize 1994.

Two litres of Tri-Fix per hectare. All had lime and fertiliser.

	Tri-Fix	Control	
Total yield	33,000	28,000	14% increase.
Crude Protein	20.6%	18.2%	14% increase
Crude Protein kg	6,798	5,096	33% more total protein per hectare.
ME in MJ per kg	11.5	11.7	Faster growth lowers ME, so be careful with figures.
Ash	18.2%	16.9%	Equals more minerals.
Dry matter	9%	10.8%	Faster growth lowers the percentage dry matter.
Nitrogen	3.3%	2.9%	Faster growth increases nitrogen.*
Phosphorus	0.37%	0.35%	
Potassium	5.8%	5%	
Sulphur	0.65%	0.60%	
Calcium	2.3%	2.2%	
Magnesium	0.32%	0.31%	
Sodium	0.34%	0.32%	
Iron	118 ppm	119 ppm	
Manganese	57 ppm	62 ppm	
Zinc	58 ppm	53 ppm	
Copper	5 ppm		5 ppm
Selenium	Not done	0.08 ppm	
Boron	25 ppm	20 ppm	
Iodine	0.16 ppm	0.12 ppm	

* If grazing green maize or feeding as silage with good clover based pasture, the total protein level will be OK, but if fed on its own or with hay, the protein will be too low. Harvesting at 50% as silage

We, Bill and most of our clients didn't side-dress because it is an unnecessary cost which encourages shallow rooting of the large deep rooting plant that causes the maize to grow faster initially and wilt in summer once our typical dry weather starts, causing a lower final yield. See Roots above. The fertiliser mix was based on a pasture tissue analysis that showed that potash, magnesium and zinc were adequate, so were not applied.

The soil pH was 6.1, but needed and responded well to 8,000 kg per ha of lime, 1,000 kg of Gafsa, 400 kg of serpentine, and trace elements, showing how useless the pH measurement is for deciding on lime.

The lime was spread onto grazed pasture, rotary hoed once and then chisel ploughed, fertiliser was then applied and chisel ploughed in going in a different direction.

Some farmers spray to kill the pasture, some graze it short and trample it then rotary hoe finely and shallowly. The fertiliser mix was broadcast and chisel ploughed in to 40 cm (16 inches) deep. See Cultivation > Chisel Ploughing.

The amounts of fertiliser and cultivation may seem high, but the land in this area is worth NZ\$40,000 per ha (US\$8,000 per acre) for bare land, so yields have to be high to pay interest of NZ\$3,000 per ha (US\$2,000 per acre) pa at 7%, and make a profit.

Note in the first photo that the correct density of plants per hectare (100,000 or 40,000 per acre), the maize is being harvested while the bottom leaves are still green and growing indicating adequate fertility because sufficient slow release P and S were cultivated in. Most maize crops by this stage have the bottom leaves dying because fertility has run out, so losing feed value for silage.

Twenty-five years of grazing pasture since the last crop had built up the soil's organic matter to 11%. A crop like the above lowers it by about 20% to about 9% in one year. If all the silage is fed out on the same paddock organic matter will increase again, but this is not practical, however silage increases the soil's organic matter levels where it is fed.

The maize was sown with 100 kg DAP drilled in per ha which is not necessary if adequate animal or poultry manure or compost is chisel ploughed in. The maize sowing contractor recommended it - only because most growers do it and at higher rates because they don't understand growing maize. It is far better to chisel plough DAP in with the main fertiliser. Our neighbour is Chinese and his father in law came on a visit. He was in charge of growing thousands of hectares of sweet corn in China and told me that they like to encourage deep rooting of young plants and do this by not irrigating until its roots have gone down for moisture.

In 1986 the best crop I saw, and the harvesting driver agreed, in the Waikato was on our Greenhill Road farm 2 km east on Hamilton. It is shown here for grain with Ian Dobbs (1.75 m tall), our son-in-law who share-farmed brilliantly for us. It had 8 tonnes of Rorison's lime per ha and fertiliser as above, all chisel ploughed in 40 cm in one metre deep consolidated peat. The previous maize crop had been harvested for grain and the stubble strip grazed, so returned in animal manure. The weeds along the fence line at the bottom right are *Amaranthus*. Some asked why we didn't spray them. They don't grow in pastures that are correctly fed with lime, fertiliser and trace elements, and they are feed for cattle when grazing the stubble. The 35 hectares was sown in pasture and no weeds grew. See Weeds.

In 1992/93, three of the best maize crops I saw in the Waikato were grown by my clients. They were Bill Chynoweth on loam north of Cambridge (Page 1 photo.), Craig Clausen on peat near Gordonton and Colin Marshall on clay near Te Awamutu. All used Sechura reactive phosphate mixes at 1,000 to 1,200 kg per ha depending on the paddock fertility, all chisel ploughed in. All used Tri-Fix at two litres per hectare.

Bill Chynoweth frequently grew maize crops of over 30,000 kg per ha using reactive phosphate mixes and 100 kg per ha of DAP if animal manure was not applied in some form (effluent, wintering on, or poultry manure). After I retired from consulting because of gluten problems without knowing for eight years that it was the cause of frequent visits, his yield dropped to 24,000 kg in a good year because of him going back to a Single Superphosphate mix (at a MAF consultant's recommendation) and without Tri-Fix, losing him \$2,000 per ha.



A trial in Uruguay (reported at the International Grasslands Conference in Saskatoon) showed that, "Three years in maize followed by three years in pasture, gave more total grain than six years in maize." This seems hard to

believe and there could be so many other circumstances, such as what was the total net profit, allowing for pasture seed and re-fencing, but it does show the benefits to maize of organic matter in the soil.

Those who grow maize for two years then pasture for eight have no problems establishing pastures, but more than two years in maize will lower the soil organic matter to levels to < 3%) which is too low for perennial ryegrass to establish and survive, so clover takes over causing a bloat nightmare.

Some sow winter ryegrass after maize and sell it as silage, then within 10 days sow maize. Grazing the winter grass with dry dairy cows could be more profitable overall as the organic matter would be returned to the soil for higher maize yields.

Deficiency symptoms

Maize is such a fast growing plant that any mineral deficiency affects it adversely and shows up quickly.

- A purple tinge with stunting, can be from low phosphorus.
- Slow growth after sowing can be from being planted deeper than 5 cm (2”), especially in heavy clay wet soils. The plant uses most of its energy in pushing up through the soil, so has a sick yellow or purple look and doesn’t grow until its roots establish. This is worse in cold wet conditions. Adequate lime and boron with other deficient elements loosens most soils. This 15% higher yield is worth \$75 per hectare for a cost of \$40, and gives healthier grain. The extra can be 25%.



- Cobs should look like this sweet corn of ours which had adequate boron.
- Kernels not growing growing to the tip or on the stalk side of the cob indicate low boron. Low calcium and dry conditions* increase the symptoms of low boron because the roots don’t get to it. In deficient soils, cultivating in as little as 2.2 kg of pure B per ha (2 lb per a) has increased maize grain yields by 15% in Florida. This is contained in 20 kg of Ulexite slow release (best) or in 20 kg of Boronate32, both of which have 11% boron.



* Some blame the symptoms on droughts, but calcium and boron reduce these effects - provided they are chisel ploughed in deeply and thoroughly. Dig under your maize plants to see how deep the roots go. Lime and fertilisers harrowed in or side-dressed are of little or no help when rainfall is limited. 250 kg of DAP per hectare drilled in when sowing, gave an excellent start to a crop that later dried up quicker than others because many of its roots would have been near the surface.

- Low zinc can delay silking and tasselling in maize and reduce chlorophyll activity resulting in yellowish or white blotches between the veins on leaves. Stems can be stunted with bunched up leaves. Low calcium makes the curled in leaves worse. If needed, the cost of 6 kg per hectare of zinc sulphate is usually enough, and costs only NZ\$16 per hectare (US\$4 per acre), which is nothing for a big increase in profit.

- Cold wet weather can cause a blue tinge on leaves.
- Dwarfed and thin shoots, pale green leaves, sometimes with a red tint on stems and leaves can be from low nitrogen.

- Normal growth with yellow streaks over the whole leaf indicate a magnesium deficiency. Red and yellow tints towards the points of leaves show a severe of deficiency.



- Leaves spotted or striped can be from low calcium and boron, but blight can be blamed.
- Leaves wilted or tightly rolled can be from dry conditions, insects, root or stalk damage, chemical damage, or calcium deficiency.
- Leaves going yellow and dying can be from Argentine stem weevil.
- Plant cut off - cutworm. Dig around the most recently eaten plant to find it.
- Thin spindly stalks can be from low nitrogen and/or other growth elements, plants being too close together (over population), wetness, root damage by insects or machinery.
- Potassium deficient maize stalks have nodes closer than normal and leaves longer than normal, relative to the height of the plant. Cobs are shorter and plants lodge more easily. High potassium levels reduce magnesium uptake and lower maize yields.

Applying about 100 kg of Serpentine (23% Mg silicate), 40 kg per ha (36 lb per a) of calcined magnesite (40% Mg) eliminates Mg deficiency.

Boron must be at the optimum level. If lacking, maize can have 25% fewer cobs and cobs can be shrivelled with no kernels on the side adjacent to the stem, and fewer on the tips as shown here in grain maize where B

deficiency was accentuated by a dry season (2007/8). B is in minute amounts in soils and is not mobile so in dry weather more is needed.

For crops, chisel ploughing RP to at least 30 cm on mineral soils and deeper on peat, is essential. Don't broadcast it on top and leave it there, or even just harrow it in. In Winter rainfall areas like all of New Zealand, when summer crops are sown, rainfall is usually low and decreasing, and the crop roots penetrate the soil rapidly. All fertilisers give much better crops if chisel ploughed in.

This maize seedling is only 13 days old. The leaves are 8 cm (3 inches) high and the roots are 11 cm (4 inches) deep. It shows how quickly maize roots go down, so for top yields, fertilisers must be chisel ploughed in. Check pasture and other seedlings and you'll find the same, i.e., roots go down much further than leaves and stems grow up.



Mixing in reactive phosphate

Chisel ploughing RP in, mixes it with the soil, which increases its soil contact and makes it become more available to plants much more quickly, which is necessary for fast growing crops. See the 33,000 kg DM per ha maize crop on page one for evidence of successful use of RP.

Even if water soluble fertilisers are used and not chisel ploughed in, they will not be washed down quickly enough to feed the fast growing roots that can go to half a metre in deep soils.

Leaching causing aquifer pollution is increasing, caused mainly by water soluble fertilisers, so they should not be used unless essential. Lime and deep chisel ploughing encourage deep rooting that gives the roots more time to absorb elements before they leach out of reach.

High lysine maize needs even more B. See Elements > Boron. Lysine is an essential amino acid necessary to work with protein in animals. It is low in grains and high in legumes. It helps absorb calcium and develop muscle.

Some maize and other crop failures have been the result of NOT chisel ploughing the fertiliser in, especially boron which must be mixed in thoroughly and deeply, otherwise the roots don't access it, especially in dry weather.

Fertiliser

As well as a mix of reactive phosphate and necessary elements, which should be chisel ploughed in, sow maize with a starter fertiliser like DAP at no more than 150 kg per ha (134 lb per acre), but a starter should not be applied if animal or poultry manure or mob stocking as a sacrifice area provide the N. Don't use DAP on pastures or grazing crops because nitrate poisoning of animals can occur, although drought stressed maize if



grazed before maturity can also kill animals, especially if rain falls on drought affected plants which then take up soil nitrates quickly.

The back half of this paddock yielded 5,000 kg per hectare more thanks to Tri-Fix from Elisio Ltd, Box 491, Pukekohe, New Zealand. Email: balle@paradise.net.nz. Ph +64-9-236-8094. It was sprayed on the soil at two litres per hectare (2.9 US pints per a) and harrowed in just before sowing. It cost \$140 per ha (US\$30 per a) plus application costs. It seems to reduce N leaching, making N available to the crop for more of the growing period and holds the soil's moisture. If you don't believe this, do a trial and feel the soil of both areas through dry periods. You'll be amazed. I've used and seen Tri-Fix outyield others since

It also gave better and higher feed value in brassica and maize crops, and a profitable return on all the four comparative trials I organised in 1993. The trial figures and photos are available from the Elisio Ltd.

Some recommend all fertilisers to be applied on the surface, but those of us who have done comparative

trials know that fertilisers chisel ploughed in give better yields in all cases for new pasture to all crops. Some water soluble fertilisers can leach down, but can also be leached too far and take other elements with it and be lost*, whereas the far better reactive phosphate fertilisers with elemental sulphur do not leach at all and are best mixed with the soil to make contact to become available.

No-till which places fertilisers near the surface doesn't give yields as high as fertilisers chisel ploughed in. The no-till trials I've seen quoted are compared with the old fashioned mouldboard ploughs which Plowman's Folly and Malabar Farm proved 60 years ago are not as good as chisel ploughing. If a no-till sales person calls on you, ask for a dozen names of farmers who have used it for ten years. Even John Baker doesn't know (or doesn't want to know) why farmers give up no-till after a few years.

A trial in Uruguay (reported at the International Grasslands Conference in Saskatoon) showed that three years in maize followed by three years in pasture, gave more total grain than six years in maize. This seems hard to believe and there could be other circumstances, such as what was the total net profit, allowing for pasture seed. However maize grows extremely well after fertile grazed pasture and uses the soil's organic matter reserves that can halve in three years under maize for silage.

High yields are essential

The total cost, including 9% on land value of NZ\$30,000 per ha (US\$9,100 per a) and interest on the outlay of growing maize are quite high - so maize yields must be high. Calculate yours exactly on the spreadsheet Pasture Silage Hay Crop Costs where you enter your costs, land value and yields and if required 'what ifs'. The exact figures are not critical, but having an approximate idea is.

The following shows the importance of high yields.

Silage dry matter yields			Costs		Net at 35 cents/kg	
Yield	kg per ha	lb per a	NZ cents per kg	US cents per lb	NZ\$ per ha	US\$ per acre
Top	30,000	27,000	20	15	\$4,500	\$1,275
Average	24,000	22,000	22	17	\$3,120	\$884
Poor	18,000	16,000	27	20	\$1,300	\$408

Measuring yield

Maize silage should be harvested between 30 and 38% whole plant dry matter.

Cut one or more average plants into 25 cm lengths, dry and weigh them separately, then multiply by the sowing rate (90,000, 100,000 or 120,000) for yield per hectare.

Drying can be in the sun or in a microwave - **SLOWLY** to avoid charring.

A new spreadsheet has been added to the 50 spreadsheets. Called 'Elements bought or removed in silages', it shows the financial value of elements and organic matter from buying and feeding pasture and maize silage on your farm. It shows that buying maize silage at low prices, can be good value, while selling maize silage reduces the farm's organic matter level which is hard to replace. Growing maize for silage on effluent dairy paddocks that usually have high organic matter can be beneficial and reducing the typical high potassium levels in effluent paddocks that adversely affect animal health, and subsequent clovers certainly will be. See Elements > Potassium.

Growing maize for green feed, silage or grain, need soils that are well drained (note the lower yield on the wet area), fertile (with adequate boron), warm (no frosts in the growing period), well limed and fertilised, with rain or showers during hassling.

The maize in the wet hollow will yield only half as much as the well drained on the left.

This crop in the Waikato is typical and will average about 25,000 kg per hectare of dry matter for silage.



Sowing

Seed rates vary from 60,000 to 125,000 seeds per hectare (24,000 to 50,000 per a). The low rates are in dry

areas where rows can be 1.5 metres (60 inches) apart and the high rates are in fertile soils with high rainfall where rows can be 38 cm (15 inches) apart for silage. Sowing rates for silage are higher than for grain. In the recent dry summers, 80,000 yielded more than 100,000/ha

Rows running east/west can yield 1 to 2% more than rows running north/south because of the extra sunshine caught and the rows shading the soil which retains moisture. If it means very short rows it may not be worth it.

Early sowing can give higher yields, especially in dry summers, so ensure that drainage is perfect and chisel plough to keep most of the warm soil on top. Mouldboard ploughing buries it and brings up cold soil so delays sowing. Chisel ploughs with photos are shown in Soils > Cultivation.

Don't sow until frosts are over and the soil is about 18° C at 7 cm (64° F at 3"). If for grazing, plant in blocks a few weeks apart. As with other summer crops, late plantings can fail to germinate through lack of moisture.

Our second 107 ha (264 a) mostly shallow peat farm at Puketaha in the Waikato, was growing maize. We found that seedlings on the black peat in the first three weeks grew double the height of those on the light brown peat. We analysed the plants and soils, and later found that the only difference was that the soil temperature was higher in the black peat. The brown peat that was from the peat being burnt decades before, was lower, wetter (drainage was good), colder in spring and winter, and had no benefits. Organic matter in soils give it a darker colour so if exposed, it will warm up sooner in spring.

Germination failures occur frequently. They can be from low germination of the seed, dryness, mould caused by insufficient moisture, burying too deeply, or too shallowly so that seeds dry out or are taken by birds or insects such as crickets. Poor germination can also be caused by insects eating the seedlings as they germinate, but the seed can get blamed.

Superstrike coated seed, or if soaked in diesel for a few seconds, reduces most of the insect damage.

Weeds

There are selective sprays that control some weeds without harming crops, but prevention by cultivation and sowing within two days and good overall management are best. The reason for this is because weed seeds germinate after seeing light so start swelling as soon as cultivation starts, so they get a start on the crop.

To reduce weeds in crops, some organic growers in Germany cultivate at night without a rear light on the tractor, or they cover their cultivation equipment with black plastic sheets to prevent light getting to the soil. Treat every weed like a noxious poison and don't allow any to seed on your farm.

Pests

Before treating any problem calculate the cost benefit, and the ecological effect, for example army worm has a parasite wasp that will die out if all army worms are killed by sprays. Army worm in NZ used to be a problem before importing the wasp. Watch regularly for army worm, a smelly caterpillar that eats leaves and cobs, mostly at night, and check for the wasps.

Pests such as cutworm and Argentine stem weevil and weeds can reduce yields. If necessary spray against insects, but wintering animals on the paddocks to be sown in maize (or any crop) and/or using them as sacrifice paddocks with on/off grazing, tramples insects without sprays and reduces over-grazing and pasture damage on the grazed paddocks in wet weather. Cultivation costs are reduced and fertility from the animal manure increases crop yields and reduces deficiency problems.

Argentine stem weevil which lives in most pastures in the warmer parts of some countries, eat out the centres of maize plants, which then makes the leaves go yellow. Treated maize seed is sold, but insects have to eat some plants before being killed by the poison in the seedling. Even when using treated seed insects can damage older plants after the effects of coatings wear off. Damage can be patchy, so monitor the whole crop daily and spray if necessary. If you use treated seed, remember that before it kills an insect, the insect will have eaten a seedling or two.

Mob stocking on sacrifice paddocks before cultivating controls insects. Grazing maize stubble also reduces pests. If you plate hoe (large chunks of turf), Argentine stem weevil will survive in the large lumps of turf for months, or for as long as the lumps of turf are there and alive, and even if you chip hoe (small chip size lumps) some insects will survive, so check for them daily and spray to control the Argentine stem weevil and cutworm.

Plan to control ducks, because, depending on the number in your area, they can ruin maize sowings. A good farm dog can be trained fairly quickly to chase ducks, but will need help on large paddocks where the low height of a dog doesn't allow them to see landed ducks.

Varieties & sowing

Specific varieties and sowing rates are not recommended because of the large variation between seed sizes, soil condition, climate and rainfall. For example maize for green feed in the Waikato is sown at 100,000 kernels per ha (40,000 per a), whereas in some areas this rate would result in plants competing for moisture and fertility. Use local knowledge for things such as seeding rates. If unsure do your own trials. Several companies have developed maize varieties in New Zealand that are best suited to particular conditions so sow the best one for your area. Check with local growers as well as all the seed suppliers for the best variety and sowing rate for your area and soil. Modern early maturing varieties have, in many cases, been safer against late and early frosts, outyield slower maturing varieties and free the paddock sooner for regrassing.

Seeds must not be allowed to come in contact with fertilisers except rock phosphates, serpentine superphosphate or lime. Nitrogen, potash and trace elements such as boron can adversely affect germination.

Grain varieties can, with their higher cob to stover ratio, produce a higher feed value silage. Also if all the maize is not needed for green feed or silage, it can be harvested for grain.

In USA a maize with few cobs for silage has been developed, but cobs contain starch and in NZ where animal feed is mainly high protein pasture, starch is needed. Maize silage without cobs has an ADF of about 40% and protein of 7%, digestibility of 60% and an ME of only 8 or 9. Its bulk fills the rumen & being slowly digested reduces animal appetite. Starch is digested rapidly so works well with pasture which is also digested rapidly and enhances rumen activity to digest the fibre in the rest of the maize. Fast digestion makes way for more to be eaten which increases animal production.

Check germination weeks before sowing time by placing 100 seeds on a paper towel on a plate, covering it with another paper towel. Warm water and a plate shower cap keep it moist. Place it in your house where you pass it daily - not in a hot cupboard where it can quickly dry out and not be noticed. Poor germination is costly and impossible to correct so needs checking. Good seed should have a 90% or better germination rate. 100% is rare because most seeds are mechanically harvested on one day when some seeds will be over mature and some under mature or green.

Maize should be planted in early November in most Waikato areas. It is a vigorous grower so needs ample fertiliser, as does the pasture following it, or failures will occur. A 33,000 kg per hectare maize crop will remove 122 kg P per ha (110 lb per a).

Hybrid seed is expensive, but if well managed can give a profitable return, even for silage. Don't use cheap "munch" green feed seed. A good hybrid will usually outyield it by much more than the extra cost of the seed. Twelve month old cheaper hybrid seed may be OK. Germination test it - it may still be adequate for green feed sowings at a slightly higher rate. Other costs are the same so don't skimp on the seed cost.



Protein

Protein animal feed is one the costliest things to grow or buy and pasture protein levels per kg of DM are double those of maize (see below), so while a good maize crop yields in six months about twice the dry matter that pasture yields in a year, it yields only the same total amount of protein per hectare as pasture, and costs a lot more to grow.

Mineral levels

	Green maize	Perennial ryegrass & clover pasture
Protein	10~14%	18~25%
Phosphorus	0.3%	0.45%
Potassium	2.2%	2.8%
Sulphur	0.2%	0.4%
Calcium	0.4%	0.8%
Magnesium	0.2%	0.24%
Sodium	0.02%	0.2%
Iron	125 ppm	150 ppm

Manganese	70 ppm	50 ppm
Zinc	40 ppm	50 ppm
Copper	12 ppm	13 ppm
Boron	15 ppm	22 ppm
Molybdenum	0.3 ppm	1.5 ppm
Cobalt	0.1 ppm	0.1 ppm
Selenium	0.1 ppm	0.3 ppm
Iodine	0.5 ppm	0.5 ppm

My investigations indicate that the low level of Se in maize is accentuated by low Ca soils and the low levels of Se in NZ soils. The aimed-for level in the Northern Hemisphere TMR is 0.3 or 0.4 ppm.

Grazing maize

Supplementary minerals are beneficial for animals grazing pastures, but are absolutely essential for those fed more than 20% of the diet in maize.

Maize can be grown as a forage crop for grazing to reduce the summer slump period or for a high yielding silage crop, however keep in mind that maize on its own is a low protein and low mineral feed, but fed with lush pasture and minerals is excellent.

Maize is very low in most minerals (only 0.02% sodium - good pasture has 0.2%) so supplementing is essential if the amount of maize fed is above 25% of the total diet, but with grazing a good soluble mineral mix (SMM) like DeLaval Feedtech should be fed in the drinking water to all animals all year. If a good soluble mineral mix with salt and seven other elements is not fed through a dispenser then add salt to the maize silage at 1 kg per 1,000 kg (1 lb per 1,000 lb) of DM for dry cows and nearly double that for milkers. Feed less salt for three weeks before calving to avoid udder oedema.

If good concentrates with minerals are fed, then the minerals can be included in it.

If necessary add dicalcium phosphate (ensure it is low in impurities) at about 4% by weight. Don't supplement with calcium before calving because it makes the digestive and transfer systems inefficient and milk fever can occur. If low because of not applying optimum lime, feed some immediately after calving. Check with your vet and/or nutritionist. All tropical grass types (maize, millets, Jumbo, Nutrifed) are very low in sodium (0.02%) and some other minerals, so, to get optimum animal production and health when feeding them, supplement with DeLaval Feedtech, the only complete one with nine elements.

If fed when too immature it is poor feed, and if over-mature its digestibility is reduced. Maize takes a lot of cud chewing and digesting so when too old, dry and hard, chopped too short so can't be regurgitated, it doesn't get chewed so grain and fibre are sometimes seen in the animals' manure. Grazing it green with grass like this can achieve 90% utilisation.

Maize can be mown or rolled before moving a high power fence over it. A long feeding face is necessary so all cows can get equal amounts of crop. If necessary, from the gateway fence two or three sides to give a long feeding face to reduce trampling and stock milling around.



Colin Marshall's cows near Te Awamutu in the Waikato grazing forage maize that has been mown to allow the electric fence to be moved. Note the clean grazing (no waste) behind the cows and no dust when dry nor mud when wet.

The grass growing in the maize was intentional from chisel ploughing without spraying the old pasture. It allows changing to and from grazing maize to be done more quickly without digestive problems because of the grass in it. As well as giving a higher yield of dry matter it reduces dust, or mud if it rains. It will grow after grazing and just needs the latest grasses and clovers to be oversown and trampled or drilled in after the maize has been harvested.

The yield here is about 27,000 kg of dry matter per hectare. More lime, more fertiliser and deeper chisel ploughing of good soils with optimum rainfall, can yield 33,000 kg per hectare.

Grazing dry maize stubble (stalks) after grain has been harvested

Maize yields a tremendous amount of dry matter (up to 33,000 kg per ha of DM). This comes from the soil, so if not there to start with will not give a high yield and if not replaced, after several crops the soil organic matter can decrease to about 2%. Maize can produce from this level, but does so much better if OM is higher, but good perennial ryegrass and clover pasture don't thrive at under 5% OM. Grazing the stubble helps by returning the animal manure, but best of all is an occasional green manure crop. In climates where a winter ryegrass can be grown, just 14 weeks of growth cultivated in improves soils amazingly.

Better still can be what some Swiss farmers do which is broadcast white clover over the maize when it is about 15 cm high. After harvesting the maize the clover is there and then grows well. It can be grazed or cultivated in. Using clover reduces the amount of nitrogen needed with a winter ryegrass green manure. Grazing the ryegrass and having the animal manure dropped on the paddock also helps.

If using sheep to graze grain-harvested maize fields be careful of spilt grain overload causing acidosis. It can be minimised by gradually introducing ewes by giving them only an hour a day to start with and then gradually increasing it. All animals should be introduced to maize stubble and to all feed changes gradually over ten days or more.

A lot of maize stalks are not grazed so are wasted every year, quite often because of previous bad experiences caused by mineral deficiencies and bad grazing techniques of not mowing first and not controlled grazing. Feeding soluble minerals in the drinking water can make animals strip grazing corn stalks thrive. A mobile trough can be used. Allowing them to walk all over large areas of stubble gives them too much on the first days and not enough after that.

Watch for excessively dry heaped up dung. Sometimes Molvinate or molasses are necessary.

After harvesting for grain, allocate a daily break of maize stubble with back fences, as done on pasture. This makes a good job and reduces pugging which can cause soil damage in winter rainfall areas. Keeping the animals bunched in squares keeps them warmer and reduces walking which wastes energy and pugs the soil. Cultivation after thorough grazing is much cheaper taking only two chisel ploughings and perhaps a roller cultivation. The animal manure adds valuable animal organic matter to the soil which both earthworms and future maize or pasture appreciate.

We've contract grazed dry cows at NZ\$9 per head per week (1986) and our own 19 month old beef on maize stubble very successfully (net profit after the grain), after discovering that -

- The change to feeding maize stubble after grain has been harvested should be made gradually to allow the rumen microflora to adapt. Give them some grass and some stubble over the first week at least. Grazing the grassed headlands and edges of fields, and perhaps the roadsides, at the same time as the stubble for the first few days, and then over the last few days the same gradual change should be made back to pasture. Silage or hay can also be used, by slowly getting the cows on to a high percentage of either before changing them gradually to maize stubble. It takes at least ten days for the rumen bacteria to fully adapt to a change. Alternatively graze some pasture in another paddock to smoothen the change.
- Grazing the stubble should start the day after harvesting and if possible harvesting should be staggered because the stubble deteriorates quickly after harvesting, especially in rain.
- Cattle have to be fed the best soluble mineral mix (SMM) in the drinking water at 0.006% of live weight/animal/day giving a 500 kg cow 30 grams (1,100 lb cow 1 ounce) because, while there is a little energy and not much protein in maize stubble, there is almost no sodium, and very little of many other minerals. Because animals drink so much when grazing maize stubble it is easy to provide SMM through the drinking water using an on-line or Peta trough dispenser and a mobile water trough fed using an alkathene pipe or with a tank on wheels. Licks and blocks are over consumed by some and ignored by others, resulting in failures. A good SMM can halve mineral supplementing costs and costs nothing because the animals do so well and eat less. We learned this on our beef farm where we reared 160 calves each year and did a trial with 80 on soluble mineral mix and 80 without. Those getting it grew faster, needed less worm drenching and consumed less pasture each day. See Minerals.

About 50% more dry matter than normal has to be fed to make up for the lower feed value and low digestibility. If possible it is best to feed them as much as they will clean up plus a little pasture, silage or hay depending on the age and quality of the maize stubble.

If no pasture, silage or hay is fed, then molasses or sugar should be fed to aid digestion and reduce the

possibility of binding of the animals' digestive system. If dung starts getting too firm or some animals eat less (watch them and watch their paunch fill), act quickly with some pasture.

Our second farm was all growing maize when we bought it. We converted a third each year to pasture. Mowing stubble close to the ground, as shown here, a few days just ahead of grazing allows stock to eat more of the stubble, simply because animals will seldom stand and chew vertical standing stalks, but will eat them if mown so they can be picked up and chewed before swallowing.



The bottom left corner of the photo shows how cleanly they ate it the day before.

Mowing it close the ground -

- Increases the amount of feed obtained from the paddock.
- Encourages stock to consume more.
- Helps stock do better.
- Leaves the land cleaner. See Soils > Cultivation.
- Consumes, tramples and/or starves more insects such as Argentine stem weevil, slugs and beetles. Under no-till and minimum-till, insects increase and yields go down. The animals' hoof action reduces the insects. Soils need deep chisel ploughing in of lime to improve the soil and obtain good maize and subsequent pasture yields. When reactive phosphate is used it has to have fine sulphur mixed with it and be chisel ploughed in to mix it with the soil to make it quickly available for the fast growing maize to benefit from it.
- Allows smaller areas to be given so animals are closer together and keep warmer. This is important. Making the blocks as near to square as possible is also important to stop them wasting energy by walking up and down long breaks or all over the paddock, and to reduce stubble waste and soil damage.
- Makes the more concentrated mob trample some of the maize roots and any weeds into the soil starting the cultivation and decomposition of any remaining stubble at no cost.
- Saves the hassle of having to mulch stalks or having them restrict cultivation. Good cultivation can then be achieved before the next sowing with fewer fast deep chisel ploughings without blockages, followed by a rolling and sowing.
- Gives more even germination if sowing pasture or small seeds after maize because there are no stems to cause bare patches from stalks dragging the seed. Bare patches can end up growing weeds. If there is still stubble, use brush tied behind the roller packer to bury the seed rather than a harrow or anything which can drag stalks.

Some may say that the mowing the stubble is a cost, but it pays for itself in less waste, extra feed and reduced cultivation costs.

If all the above things are done, stock can do well and have a healthy bloom. If not done, stock can drop in condition. Happy dairy farmers brought their dry cows back to us every year to graze our maize stubble.

To get dry dairy cows from dairy farmers you'll have to do a good informing job because so many have had cows lose condition on maize stubble.

If the stubble gets old and rotten from rain it loses its feed value so feed more and supplement with good silage or hay in that order, because they'll need moist feed, not dry hay.

In wet conditions avoid excessive pugging of the soil which can damage the soil structure. If it does pug,

aerate it with a chisel plough or subsoiler as soon as possible to break the seal which forms and prevents gases from escaping and air from entering so turns the soil into an anaerobic dead soil.

In Switzerland some maize growers broadcast clover seed at 1 kg per ha (0.9 lb per a) just before the maize is too long to get a tractor or ATV through. In dry areas it may not be advisable because the clover would compete with the maize for moisture. It only grows to about 10 cm (4 inches) until after the maize is harvested when it shoots away and provides good protein to go with the stubble and makes nitrogen. In cold areas sow an Alsike, in temperate Kopu II white clover and in hot areas, a red clover. Try a small area in the first year before risking the cost of doing a large area.



Leaving maize stems as shown increases the feed value of the silage when it is fed to milking cows.

Where crops are grazed in situ, nitrogen will not be necessary for about six weeks after planting the new grass, but, where maize is harvested and taken off the paddock, nitrogen may be necessary within a few weeks of sowing the grass. Maize silage and pasture are a good feed mix, but large amounts of maize without adequate pasture can reduce lysine to adversely affect animal production.

Maize as a forage crop is useful in some areas, but not where summer dry weather can start and pasture growth stop before the maize is mature enough to graze so that animals have nothing to eat. Earlier maturing crops such as Japanese millet, Nutrifeed of brassicas or a mix should be considered.

Maize stover

This is the green stalks without the ears after sweet corn has been harvested by hand and sold. It is comparable in energy content to average hay and makes good feed for heifers and dry cows, but minerals must be supplemented, especially salt.

NZ maize

Around Gisborne on New Zealand's North Island East Coast is the best maize growing area where our corn flakes, chips, popcorn, etc, are grown. Most from other areas is for poultry and pigs and a wee bit for dairy farms when they run out of pasture in late spring. Some maize grain from USA is imported. It is much cheaper because of vast areas, low land and other costs, subsidies, cheap immigrant labour and a good drying climate. NZ grain and feed companies use the possible importation of more grain to keep NZ prices down. In 1992 US subsidies were calculated at NZ\$57 per tonne (US\$40 per t), but there is no tariff placed on it by NZ.

20,000 to 30,000 ha are grown annually for silage and about 15,000 ha for grain.

There are mycotoxins in most maize, except from Gisborne. Some varieties have more than others. Fusarium can adversely affect animal health.

Turnips can yield 12 tonnes of DM per ha of high feed value forage at only a fraction the growing costs and no harvesting costs and over a shorter period than maize. The maize seed promoters and some of our deceptive researchers promoted yields of 5 to 8 tonnes per ha for turnips so made them look bad.

Some farmers have made nothing out of growing grain maize. To keep up grain supplies, some seed companies have leased land and used contractors to do all the work, or they import it from USA where it is subsidised. NZ growers have higher costs because imported fuel, chemicals, seed and fertilisers are all dearer. USA grain farmers are subsidised and dump excesses onto other markets which lowers the price local growers get.

There is a research levy on New Zealand maize growers. It is built into the price of seeds at NZ\$0.90 per 10,000 which works out at about NZ\$7.20 for grain growers and NZ\$9.00 for silage in 2006.

From dairy farmer Ian McDonald, Patetonga, Waikato, NZ.

Vaughan, I'm happy for you to quote my forage maize feeding experiences.

"We built concrete troughs for feeding maize silage in the springs of 1972 and 1974. In 1972 we used straight maize silage. I was disappointed with the milk production. I found it very difficult to ration the cows to a set amount. Some cows liked the silage so much that they ate it instead of pasture.

The second year we added Urea to the maize silage, but didn't find much improvement.

The third year we started on maize silage, but then changed to maize meal, 2kg per cow per day. There was an immediate jump in production.

In all 3 years the maize silage was used to balance high protein with carbohydrate, not because I was short

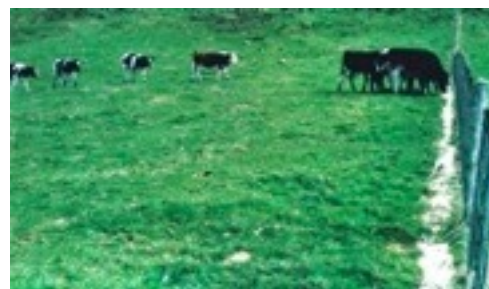
of pasture. We used the troughs to feed chopped maize in March/April, but after trying feeding in the paddocks at that time of year, we considered there was so little wastage, it wasn't worth using the troughs.

I consider the Autumn, to be the best time to feed chopped maize or maize silage. The cows milk as well on it as on other supplements at that stage of lactation, put on condition, and enable you to build up a saved pasture wedge for the winter.

It was interesting to note in an "NZ Dairy Exporter", about the 'unexplained'! increase in production from feeding maize meal, compared to the equivalent of maize silage. I think it is simply the sheer bulk of maize silage, taking up the restricted space of a cows stomach, when heavily in calf, therefore limiting space for the more productive pasture."

I think Ian McDonald is right about the maizes' bulk, so low feed value and comparatively low milk production. Cows grazing high nitrate pastures from masses of urea (which they shouldn't be), can benefit from maize silage. Also, see above regarding its slow digestion.

Since then Ian's son Paul (Ian and Ann have retired to the beach) has grown turnips each year for summer grazing by their 750 cow dairy herd with a fairly consistent DM yield of 12,000 kg of dry matter per hectare (10,700 lb per a). The costs before land value are 11 cents per kg DM (US 4 cents per lb) which is much lower than the cost of maize (see above), and grazing a forage crop costs only 1 cent per kg which is a fraction of mechanical feeding.



Here grain is fed along the fence lines with very little waste, and a lot more economically and profitably than in troughs on concrete pads, or mobile troughs which cause some animals to get a lot more than others, making herd testing dairy cows a farce.

My three most profitable beef and dairy farmers fed supplements when necessary along fence lines. Do it before the animals are in the paddock or they'll run around a lot chasing the wagon and damaging the pasture.

Look at the wasted maize and killed pasture from fine-cut acid silage not able to be eaten, so burnt the pasture. Fly over the Waikato or Google Earth and you'll see plenty of wasted maize silage and killed pastures from ignorance.



The NZ summer droughts in 2007, 2010, 2013 and 2014 meant that grazing farmers had months with insufficient pasture so milk production was down by as much as 30%, while Paul McDonald's milk yield, thanks to grazing turnips, was down by only 5%. Pasja brassica forage crop with the best millet or Nutrifeed achieves even more.

Use the spreadsheet > Pasture, Silage, Hay & Crop Costs, to enter your costs and see how much crops costs to grow, store and feed with or without your land value which can be entered. When entering the land value, to be accurate, take off the value of the main home, garden and the other buildings, which in a \$5,000,000 100 ha farm can be \$2,000,000. This shows the land value to be about \$35,000 per hectare.

This spreadsheet can also be used to plan winter brassica forage crop costs as grown in the colder South Island of New Zealand and in Northern USA and Canada, both for winter grazing.

Vaughan Jones ONZM*, Dairying honours, M.Mkt.I

*Queen's honour for services to the farming industry.

International Agricultural Consultant, Journalist & Author.

GrazingInfo Ltd