

# XtraBlatt

## Biogas production from straw

Cover story

**The Albersmeier family**  
Straw for happy pigs

**Denmark**  
Controlled Traffic Farming

**Forage harvesting**  
Sustainability pays off




 The level of excitement among the Krone team was running high in anticipation of Agri-technica returning to Hanover after an enforced absence of four years. This year's Dealer Days in September also proved to be very popular with sales partners from all over the world, who were keen to find out about the new products from Spelle and to start the new season well briefed.



## EDITORIAL

# Dear Reader

**A**gritechnica 2023, which concluded just few weeks ago, can justifiably be described as a hugely successful event. But don't just take my word for it – the positive impression was confirmed in the many conversations I had with visitors, trade journalists and sales partners. The anticipation was great, not least because of the four-year break forced on us by the coronavirus pandemic. I am convinced that the trade fair in Hanover is and will remain the most important meeting place for the agricultural and forestry industry in Europe, if not the world. I also found the general mood to be upbeat – although this should not obscure the difficulties agriculture has to contend with in reconciling market realities, cost pressures and sociopolitical aspirations. And yet I am always impressed by how much confidence the agricultural sector shows in the face of all these challenges and the way in which it adapts constructively to the prevailing circumstances – magnificent!

The entire Krone team, myself included, are currently buoyed up by a distinct sense of confidence. More than ever before, in fact. This is because we will reach two further milestones in the company's strategic development in 2024. The first of these is our new parts warehouse – one of the largest single investments in our company's history, coming in at a total cost of around €45 million. Moving and filling stocks has been underway since September, and we expect to be operating at full capacity there in early March. After that, the construction workers will start on the extensive renovation of the existing warehouse here at the Spelle premises. At the same time, our new, highly automated component production facility of Green Teuto Systemtechnik in Ibbenbüren will enter into full operating mode, freeing up prefabrication capacities here in Spelle. You can read more about the project in this issue.

All this helps us to achieve our second major target next year – a completely reconfigured assembly facility in Spelle. This construction project will open a completely new chapter in the 117-year history of Maschinenfabrik Bernard



**Bernard Krone has been Chairman of Krone Group Supervisory Board since 2020**

KRONE GmbH. The aim of this and all previous investments since 2020, totalling €200 million, is to take performance, flexibility and quality to the next level, all in the best interests of our customers. And with an even larger volume for the next three years, we are assuring ourselves of a stable future. We are inspired by these developments, and we hope that the results of our endeavours in terms of product quality will inspire you too.

On this note, I wish you and your families a wonderful Christmas season, good health and success. Here's to a great 2024!



Yours, Bernard Krone

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Huge interest in Krone technology and intensive discussions with countless customers and interested parties – we would like to thank all visitors for coming!



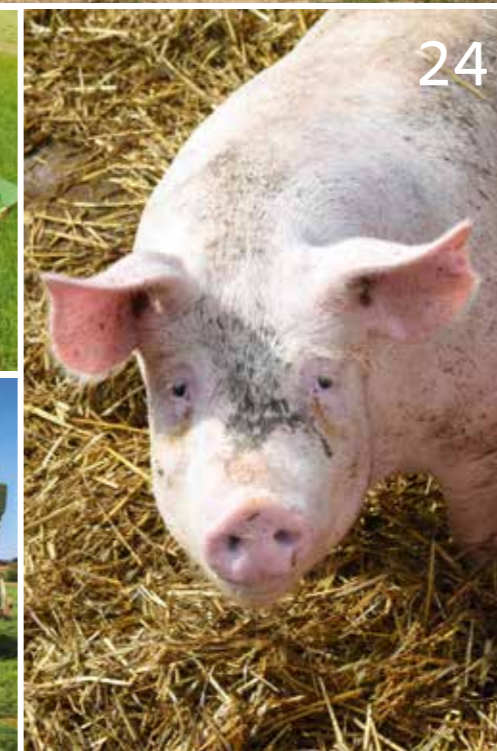
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## »» What's more



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The GraNottGas digester produces 4.5MW of electricity. It is operated on a wide range of different substrates including straw, farmyard manure, dried poultry manure and slurry.

## COVER STORY: STRAW AS FUEL FOR BIOGAS PLANTS

# An unsung super substrate

Straw is not generally the first material that comes to mind when choosing an optimal biogas substrate – with no good reason! With the right handling, it can form a valuable and economical part of the mix. With years of experience in this field, farmer Thomas Balling tells us how.

Thomas Balling caught the biogas bug, as he puts it, in 2005: "Since then, I've tried many different things, learned by trial and error – paying dearly in some cases – and achieved a lot along the way," he explains. We have come to the GraNottGas GmbH site in Grabsleben, a village in the central German state of Thuringia. The biogas plant has an electric output of 4.5 MW and a workforce of five. It has an earthy, organic smell, as you would expect. "We use a wide range of co-substrates – not just straw, but farmyard manure, dried poultry manure, slurry and other agricultural byproducts," he stresses. Thomas Balling is managing partner of the GraNottGas biogas plant, along with two others.

### Seeking the optimal combination

The now sixty-year-old first had the idea of fermenting straw on a larger scale over ten years ago: "I wanted to find out what was possible at least." His guiding principle was a particular motivation: "It's much easier for me to adapt to public opinion, than to persuade the public that what I want is right." This rationale has been a major factor in his success in the biogas industry. After an initial euphoria, the sector has been beset by headwinds, facing numerous debates ranging from land-use to the fuel-or-food controversy. "So we were forced to respond, and it's worked out well," he sums up.

The GraNottGas site and equipment were constructed and installed in two stages. On a tour of the site, Thomas Balling shows us how heat, power and fuel are generated: "In 2008/09, we had six digesters, two CHPs, a gas treatment and quality measuring facility and a gas feed-in. An additional



The plant currently operates on about 5wt% straw in combination with other substrates such as dried poultry manure, farmyard manure and slurry.

digester was added in 2014." The second stage of construction was completed in 2018 – with the addition of four more digesters, another CHP and a second gas treatment facility. "This site now has a 700 m<sup>3</sup> biomethane feed-in capacity and an installed CHP output of 3.1 MW. We feed around 12.5 million kWh of electricity into the grid," he says. "In addition, we operate an organic Rankine cycle plant to generate power from heat recovered from the exhaust gas. This technology enables us to further improve the CHP's efficiency."

Thomas Balling grew up on a farm in Franconia, a region with a distinct cultural heritage which includes parts of northern Bavaria, Baden-Württemberg, South Thuringia and Hesse. Five years ago, he put his sons in charge of managing the farm, which has since grown to 250 hectares.



The solid phase that is separated in the fermentation process is used as a fertiliser by the neighbouring farmers.



The greenhouse gas bonus makes farmyard manure more profitable than straw for biogas production.

These storage tanks will supply substrate to the digesters at a constant rate for the next 24 hours.



We biogas plant operators must make our plants more flexible.

Thomas Balling, farmer

As he talks about his career, it becomes clear just what a passionate entrepreneur the man is. "Following a degree in agriculture and an internship in the USA, I found I was drawn to large-scale farming." So when the Wall came down, he joined forces with a friend to set up "BBW GmbH & Co. KG" in the Thuringian village of Nottleben – an 1100-hectare arable farm put down to 100ha of potatoes, 250ha of maize, 450ha of wheat, 20ha of sunflowers, 200ha of whole-crop silage (WCS) and 50ha of set-aside.

In partnership with 40 other farmers, Thomas Balling had already set up two biogas plants in 2006 and 2007 in Bavaria to the south. But he was also keen to forge connections between agriculture

and biogas production in his native Thuringia. So he built two biogas plants there – again, in partnership with another farm – including the GraNottGas plant in Grabsleben.

To keep local residents on board, plant operators need to ensure that substrates travel the shortest possible distances. "When planning the biogas plant, we used a compass to draw up a list of maize growers within a 10km radius. The radius for maize and whole-crop silage now stands at around 12km," says Thomas Balling. "We source 90% of our dried poultry manure from a poultry farm 8km away, although the remaining 10% has further to travel. The farmyard manure comes from a 3km radius." They use only wheat straw grown on farm.

"We originally operated this digester the traditional way which means exclusively on maize – 80% maize and 20% whole-crop silage," Thomas recalls. "Now we're down to 35% maize." Once it was decided to shift the focus to straw and farmyard manure, he and his team began researching the optimal substrate composition. Currently, the breakdown is as follows: around 35% per cent by weight (wt%) maize, 25wt% slurry, 12wt% dried poultry manure, 10wt% farmyard manure, 12wt% WCS and 6wt% straw.

### Separator and cross-flow shredder

What are the important considerations when switching from the traditional substrate of maize and WCS to a substantial proportion of straw and farmyard manure? "Well, I have to prepare my plant to run on straw and farmyard manure by installing appropriate maceration, mixing and

separation equipment," the biogas expert is quick to respond. He indicates the separator between the secondary digester and the digestate storage tank. "When maize is used as the main feedstock, you get a DM content of 10%, because the maize is crushed inside the forage harvester and because it consists of two-thirds water so the substrate is viscous and readily forms a pumpable suspension," Thomas Balling explains. "Adding straw means adding plenty of cellulose, hemicellulose and lignin which cause the material inside the digester to demix and float to the surface." The separator prevents demixing in the digestate storage tank: "It separates the solid fractions from the liquid."

The GraNottGas team use a cross-flow shredder to mechanically pre-digest the straw and farmyard manure. This shreds up to 30cm long particles down to a length of 2cm and splits them lengthways, increasing the surface area for more effective fermentation. Mechanical maceration is a cost-effective means of creating the optimum physical conditions for fermenting straw and farmyard manure, Thomas Balling goes on to explain. He does not use enzymes. "I have yet to find a use for them with our system."

### Maceration not without limitations

But maceration does have its limits: While there is no doubt that the more intensively you operate these systems, the more gas can be produced, the biogas specialist also points out the downside: "Then I have to make higher investments, for instance increase the heat and/or pressure input, which in turn creates more work." Then productivity decreases, says Thomas. "It was clear to me from the outset that we should pre-treat the straw in the simplest way possible with the ultimate aim of extracting around 70% of its potential gas yields. That's better than exploiting 100% of its potential, while incurring 200% of the costs."

This is why GraNottGas GmbH decided not to use more costly maceration methods. "Our ideal route is as follows: straw is processed into pellets, which are used as litter for livestock and then as feedstock in our digester," he explains. So the livestock farmer benefits from the improved absorbency of pellets and the biogas operator benefits from the higher gas yields. By comparison, if the straw pellets are used solely for producing biogas the costs of pelleting will cancel out the higher gas yields. >>>

The straw is stacked at the edge of the field and then transported to the digester as required.



Farmer Thomas Balling first had the idea of fermenting straw in larger volumes more than ten years ago.



The cross-flow shredder mechanically macerates the straw and manure.





Gas treatment is based on pressure-less amine scrubbing.

Chopping their own straw in the field also aids the fermentation process. "When we first started to use straw as a biogas feedstock, the material was delivered straight from the field in chop lengths of 30cm. It was then chopped up in the biogas plant by the cross-flow shredder. But we soon saw the limitations of this approach," admits Thomas Balling. To make the shredder's task easier, they fitted a full set of knives to the square baler and then delivered straw in short 2cm to 3cm lengths.

### Biomethane processed by the energy provider

The biogas produced by GraNottGas GmbH is purchased by Ohra Energie GmbH, a regional energy service provider. "My terms for cooperating with this purchaser were that we produce the biogas and dispose of the digestate. Ohra Energie was to be responsible for processing, in other words, converting biogas to biomethane," Thomas Balling describes the decision-making process. "And I think the company is happy with this approach." In his view, the challenges in biomethane production lie primarily in the biogas plant and not in the technical implementation of the processing plant.

The latter is a mechanical process that more or less runs by itself.

However, the arable and energy farmer is convinced that anyone deciding to relinquish maize silage as a biogas substrate and focus more on straw and farmyard manure will invariably see their workload increase. "You need more staff, e.g. for the separation process. Furthermore, there must be a consistent supply of manure which then has to be processed and treated," stresses Thomas Balling. To reduce their dependency on manure suppliers, the GraNottGas GmbH team is investing in their own vehicle fleet – one lorry with pusher that collects the manure and soon another to transport the slurry. They also use contractors.

### Only dry matter produces gas

Straw is an entirely reasonable part of the substrate mix, Thomas Balling is keen to stress. "Since the material is already there, no additional arable land is needed to grow the feedstock." He often hears other farmers voicing concerns that taking straw from the field will be detrimental to their humus balance. "That's correct if you don't then return

it to the field," counters the specialist. "But you can use it as bedding and in the digester and then spread the digestate on the field. That's what we do here. The solid phase still has 28% DM and the liquid phase 5%." He also says that there is scientific proof that this approach produces the same amount of humus as when the straw is left to rot on the field.

Another advantage of using straw is that this material increases the renewable raw materials bonus which is paid to German bioenergy producers. "You get an higher bonus if your biogas plant complies with Germany's 2012 Renewable Energy Act (EEG)," Thomas Balling maintains. "That's worth two cents per kWh for each tonne of straw used." This makes the process more cost-effective, and offsets the additional costs associated with it. "While we're on the subject of cost-effectiveness," he adds, "farmyard manure entitles you to the larger climate credit via the GHG quota." Prices for methane produced from maize are currently running at around 11 ct/kWh compared with 13 ct/kWh for straw and 19 ct/kWh for farmyard manure.

Furthermore, using straw reduces dependency on other substrate suppliers. "You don't have to start with a 15% straw fraction," advises Thomas Balling. "5% is often enough." One tonne of straw replaces 1.5 tonnes of maize and, he adds: "Maize contains 33% DM and straw 86%. And it's only the dry matter that produces the gas!" The important thing is to manage straw handling to your advantage. "Before selling my straw elsewhere at a higher price, I obviously have to decide whether that's a cost-effective option," he points out.

The savvy businessman does some more calculations. "If I chop and distribute the straw in the field or harvest it at low costs, each tonne of straw that goes into the digester costs 40 to 45 euros. That's what many folk pay for a tonne of maize silage, but they get only two thirds the gas yields they would get from straw. These are the things you need to bear in mind when considering whether or not to produce biogas from straw."

### On the right track with straw

In future, all biogas plant operators will have to adopt a more flexible position in choosing their feedstock, says Thomas. Germany's National Biogas Strategy has set a maize cap of 40% for 2023, falling to 30% in 2026. "This means that all operators will have to explore other options," Thomas concludes. The German Biogas Asso-



The heat distribution system.

ciation – of which he has been a board member for more than two years – has been campaigning against the maize cap for years although they are aware that such restrictions will be inevitable. "We biogas plants operators must make our plants more flexible so that we can provide backup when weather conditions prevent the generation of wind and solar power," he concludes. This means increasing CHP capacities in addition to installed output on the one hand, while at the same time switching to alternative substrates on the other. With straw, we are already on the right track." The same applies to smaller plants, even if it means investing in processing equipment. Separation always pays off.

And what will he do when the EEG funding runs out? "Then it will be all the more important to adopt a flexible position when it comes to substrates," he adds. "There are plenty of other substrates to choose from." »»»

We aim to pre-treat the straw in the simplest way possible.

Thomas Balling, farmer

# Straw pellets as feedstock

How can straw pellets contribute to the sustainable production of biogas? This question is the focus of the University of Göttingen's StrohPelGas research project. Dr Dirk Augustin, head of the University's research farms, outlines the key findings.

The research project on the "Sustainable use of straw pellets for biogas production" looked at different options for increasing the use of straw in biogas production.



Almost 5.6t of pellets per hour were produced over several days of uninterrupted use of the Premos. Operating costs including setting-up time worked out at €66/t.

**XtraBlatt:** Dr Augustin, the research was conducted in 2020/2021. What were the aims of the project?

**Dr Dirk Augustin:** In the StrohPelGas research project, which stands for "Sustainable use of straw pellets for biogas production", we investigated different options for increasing the use of straw in biogas production. Following a series of lab research, the practical component was conducted at the University's research farm in Relliehausen. This looked at the feasibility and cost-effectiveness of adding straw pellets to the substrate.

**XtraBlatt:** How did you prepare your biogas plant for the experiments?

**Dr Dirk Augustin:** Two months before the start in 2020, we began supplying a daily feedstock of 10 tonnes of sugar beet, 11 tonnes of maize, 8 tonnes of farmyard manure and 8 tonnes of slurry. During the course of the experiment, we reduced the percentage of maize and increased the proportion of straw pellets at the same time. The straws was almost exclusively wheat straw. The aim was to maintain a constant rate of gas production, as this would enable us to determine the amount of maize we can substitute with straw pellets.

**XtraBlatt:** How were the straw pellets produced and what properties do they have?

**Dr Dirk Augustin:** We conducted market research into pelleting presses at the start of the project in 2020. Our project revolved around the Premos pelleting press from Krone. Other pelleting presses from various other manufacturers have come along in the meantime, but we have not included them in our research work.

The Premos press works by forcing the straw through two perforated die rollers at enormous

pressures of up to 110 bar. The heat that is generated in the intensive process briefly raises the temperature of the material to over 100°C, after which the straw rapidly cools again. The high pressure destroys the cells in the course of which constituents such as lignin are released. The resulting 15-mm pellets have a very high bulk density of 550 kg/m<sup>3</sup> on average. This is higher than that of maize and as such leads to savings in transport costs.



The 15-mm pellets have a very high bulk density of 550 kg/m<sup>3</sup> on average.

Here is an example calculation that shows how it could be scaled up: to supply 3 tonnes of pellets to our biogas plant a day, we need 1000 tonnes of pellets a year. The Premos would have to work less than of 20 days to achieve this. It's worth noting that the crop flow through the Premos is very much smoother today than it was on our project machine. >>>

## >>> Relliehausen Research Farm

The Faculty of Agricultural Sciences of Göttingen University operates a number of research farms for trialling, teaching and demonstration purposes. One of these farms is situated in the village of Relliehausen in Lower Saxony. At this livestock research institute, cattle, pigs and sheep, the breed "Göttinger Minipig" and trout are reared on 330 hectares of the total 1100 hectares of farmland. The farm also operates a 530kW biogas plant which is equipped with a longwave agitator and submersible agitators. This type of biogas plant is typical for many biogas producing farms. The research work here focuses on the question whether it can also be operated on straw pellets.

The use of a semi-mobile machine for producing pellets needs careful scrutiny from an economic perspective. Pellets are an economical option only when maize prices range between €45 and €55 per tonne.



If used as mobile pellet harvester, the Premos requires 12 litres of fuel per tonne of pellets. This may seem quite high, but in reality that's only 6% of the energy we "harvest" in the form of biogas.

Stored under dry conditions, the pellets maintain their shape for long periods of time. Yet, on contact with moisture, they swell up straight away and in windy weather, they may be blown around.

**XtraBlatt:** How much maize were you able to replace with straw pellets in your biogas plant?

**Dr Dirk Augustin:** Basically, straw pellets can be used in any plant. Handling is very straightforward and no additional investments are required. In lab tests we replaced 2.2 tonnes of maize with a DM content of approximately 35% with 1 tonne of straw pellets. In the practical tests, we were only able to replace 2.1 tonnes of maize, so 5% less. We assume this is because straw pellets are digested at a slower rate than the other conventional substrates. Straw has a slightly longer retention time in the biogas plant, so there is a tendency for more unfermented material to pass through the cascades.

**XtraBlatt:** At what point did you reach the limits and in which applications are pellets beneficial?

**Dr Dirk Augustin:** For us, the limit was approximately 20% of the DM in the total mix. We found that higher levels would impair agitation in our plant. But these values obviously vary depending on the particular plant and its start-up feedstock. The lower the DM content of the substrate, the more straw pellets can be used. This makes pellets particularly attractive for plant operators who use large quantities of slurry.

Straw pellets are also a useful addition in any plant that is approaching its ammonia limits, e.g. whose

substrate includes large amounts of dried poultry manure. The pellets have a very broad C/N ratio of 1/93. When it comes to cost-effectiveness, it's important to note that according to our calculations, substituting up to 20% of the substrate with straw pellets increases the energy requirement of the process by up to 10% compared with strawless substrates.

**XtraBlatt:** What are the advantages of using straw pellets as a biogas substrate?

**Dr Dirk Augustin:** For one thing, pellets result in a very low fugate (liquid phase) factor. This factor describes the feedstock : digestate ratio. Maize has a factor of 0.8, but for straw the figure is just 0.36. In other words, straw generates less than half the amount of digestate as it produces gas yields that are twice as high. If we replace 2.1 tonnes of maize silage with 1 tonne of straw pellets, we will need less than a third of the digestate storage space we would need for maize. That's a huge advantage for those with limited storage capacity and in early spring when digestate spreading is not permitted or not an option. If biogas plant operators have set aside straw pellets for this eventuality, they can use their own storage capacity and yet generate three times the amount of gas.

But in my view the greatest advantage for using pellets is explained by looking at the current situation in Germany. Producers of electricity from biogas are not entitled to any bonus for reducing greenhouse gas emissions, nor is there a carbon credit market for renewable energy plants. However, this option is available in the mobility sector, where – unlike maize, sugar beet and whole-crop silage – straw pellets are regarded as a sustainable substrate for producing sustainable biomethane. Given these conditions, the gas that is produced from straw pellets can be worth up to four times more than gas that is produced from maize. That's huge! At present, there are only a few large-scale plants in operation in the mobility sector. But the number is set to grow.

**XtraBlatt:** What are the costs associated with straw pellets?

**Dr Dirk Augustin:** We produced almost 5.6t of pellets per hour over several days of uninterrupted use of the Premos. Operating costs including setting-up time worked out at €66/t. When operating at reduced capacity, e.g. mornings and evenings at dewfall, we averaged 3.8t of pellets per hour. In this case the operating costs increased to €88/t.

If you square-bale the straw first and then use the Premos, the costs I just mentioned soon escalate. So it's clear that this type of semi-mobile operation needs careful scrutiny from an economic perspec-

tive. Pellets are then economically viable only when maize prices range between 45 and 55€/t.

**XtraBlatt:** How do the costs of straw pellets compare with those of maize as a substrate?

**Dr Dirk Augustin:** We need to look at the equilibrium price to work that out. That's the price at which the cost-effectiveness of both substrates is the same. To determine this price, we considered the digestibility of straw pellets compared with maize and the higher price of electricity generated from pellets. Then we factored in the different costs of digestate spreading based on the different quantities produced. With pellets I produce less digestate so the spreading costs are lower. Our calculations are based on a typical nutrient cycle for a biogas plant.

When maize prices are reasonable, e.g. 35€ for 1t of silage ensiled in the clamp, pellets can cost 93 €/t with digestate spreading costs of 5 €/t. But if spreading costs rise to €10/t, for example, which is not that unusual, the farmer may have to pay €99 per tonne of pellets. These production costs are feasible if no cost is incurred for nutrient removal. This invariably applies if the farmer returns the nutrients via the digestate or has no interest in the nutrients, as may be the case in some regions dominated by livestock farming. So you can see that when the maize price is low, conditions must be very favourable to enable pellets to compete purely on economic grounds.

**XtraBlatt:** And what happens when maize is more expensive, as it often was last year?

**Dr Dirk Augustin:** If you consider last year's scenario when the price of maize was 55€/t ensiled in the clamp – including ensiling losses, plants can pay up to 144 €/t for pellets. In this case pellets are a very attractive proposition even for EEG plants.

To summarise, when maize is affordable, straw pellets are scarcely advantageous, if at all, from a purely economic perspective. But when maize becomes more expensive, e.g. because it must be transported further, pellets are already cost-effective.

On top of that, pellets offer other advantages such as reduced storage volume, better shelf life and above all, the ability to close gaps. Many biogas plant operators keep up to 20% of their maize stock in reserve. This ties up capital and may limit plant expansion. With straw pellets, I have an additional substrate to use in the event of a poor maize harvest, for example.

**XtraBlatt:** What are the benefits of fermenting straw pellet litter used in livestock farming?

**Dr Dirk Augustin:** I am a huge fan of this cascading approach. Farmyard manure and slurry belong in a biogas plant. Doing this through pellets is a major advantage for most livestock farms on operational and animal welfare grounds – due to their ease of handling, low dust loads and heat-induced reduced bacterial load. However, in our project we did not look at the route via the stall.

**XtraBlatt:** Do you think straw pellets have a future in the biogas sector?

**Dr Dirk Augustin:** In my view, we will be using more farmyard manure and slurry from livestock farming for biogas production in future. Presumably we will also see increased use of pellets, partly in the interests of animal welfare. Given the fierce competition for our scarce arable land, I think we can expect to pay considerably more for maize in future, which will make pellets more competitive. But I think the greatest opportunities for straw pellets lie with the major biogas plants that produce fuel for the mobility sector. With the phasing out of the EEG, it is clear that other plants will switch to this sector, generating more demand for alternative substrates.



When maize is priced at an affordable €35 per tonne of maize silage, straw pellets offer hardly any economical advantage, if at all. If maize prices go up again, pellets become cost-effective as of now.



## Profile

**Dr Dirk Augustin** is head of the Göttingen University research farms.

# Square instead of round

Baling silage into square packs is not something you see every day – unlike round silage bales. On a visit to contractor Carsten Schulte, we discovered why square bales offer significant advantages in silage making.

**He likes to do his bit – Carsten Schulte enjoys getting behind the wheel whenever time allows.**



Contractor Carsten Schulte climbs into his tractor cab at the start of a busy day. Following a week of variable weather and heavy rainfall, it has now been dry for several days – and is expected to remain so for a while. “We recently took up mowing and raking again round here,” explains the contractor from Schmallerberg, a town in the mountainous region of Hochsauerland, at the start of our conversation. Today he is off to square-bale and wrap forage for several customers using the Krone BiG Pack 1270 VC he took delivery of just a few weeks before.

Ensiling big bales still tends to be the exception in most regions of Germany, but Carsten Schulte has been doing it for 25 years. “I bale around 7000 to 8000 bales each year with the BiG Pack 1270 VC,” he tells us. Most are film-wrapped and then left for several weeks to turn into silage, providing the basic forage ration for numerous dairy farms in the region. This process also offers clear advantages over clamping for the many small upland farms in Hochsauerland. “Logistics is already problematic on these sloping fields,” explains Carsten Schulte. Then there are the comparatively low forage volumes to contend with, especially from later cuts.

## Excellent forage

But the most compelling argument in favour of square silage bales is the excellent forage quality. “When bale production is done correctly, ensiled green forage in big-bale format provides an excellent source of forage,” Carsten Schulte confirms.

Unlike round bales, where density decreases towards the outside layers, square bales are made to a consistent density throughout. This consistency provides the ideal conditions for a uniform fermentation in all areas of the bale. The BiG Pack 1270 VC reliably cuts, compresses and knots the bales, says Carsten Schulte. However, he takes care to ensure that the crop flow through the pick-up is as smooth as possible. The length to which the grass is cut is tailored to customers’ preferences thanks to the cutting system on the BiG Pack 1270 which allows him to cut with up to 51 blades. As a contractor, Carsten insists on



The high-performance BiG Pack 1270 VC is used by contractor Carsten Schulte to make silage bales.



I bale around 7000 to 8000 bales each year with the BiG Pack 1270 VC.

**Carsten Schulte, contractor**

using Krone Original twine for the finished bale to maintain its shape. The twine is the perfect match for the “Krone V-knotter”. This double knotter produces no offcuts that either drop to the ground or, even worse, end up in the feed and a cow’s stomach where they could cause health problems. “That’s another important aspect of high-quality forage,” Carsten maintains. »»»



The BiG Pack 1270 pick-up with the multi-blade cutting system makes for perfectly cut forage.

The original Krone twine is tailor-made for the BiG Pack 1270 double knotter.

Staff member Joel Holterhöfer has become the wrapper expert.



Packed to higher densities at larger volumes, square bales contain considerably more material. As a result, baling and wrapping costs per tonne are lower.

### Special bale wrapper

The contractor uses a special square-bale wrapper for the next stage of silage bale production. Although the machine was designed for wrapping square bales, careful attention to detail is needed. "To ensure that the bales are completely airtight also at the edges, we apply six layers of chamber film", he points out. This guarantees a reliable fermentation process without harmful secondary fermentation. It also minimises the risk of mould formation resulting due to damaged film.

The higher cost of producing square silage bales and the use of premium quality film and twine

material makes these bales significantly more expensive than round bales. But this is no longer something that Carsten Schulte has to debate with his customers. "My customers understand the costs we incur to produce high-quality forage. This quality ultimately pays for itself not only in terms of higher milk yields but animal health as well," explains Carsten Schulte. And when it comes to the cost per bale, he adds: "With a higher density and larger volume, square bales contain considerably more forage. As a result, baling and wrapping costs per tonne of forage are lower – which is worth bearing in mind when comparing the two types."

### On a roll

Carsten Schulte is considered something of a pioneer locally when it comes to making round and subsequently square bales. In 2000, he was the first contractor in the region to use a baler-wrapper combination, which makes the production of silage bales a far more efficient process. Yet, only a few years later, he cut round baling from his list of services. "At the time, several farmers in the region invested in round balers to use on their own farms and for contract work and this drove down prices," says Carsten.

But that's not the only reason why he found round bales problematic. "Round bales roll – and in the hilly fields in this region, they sometimes set off on their own," the contractor explains. On fields close to roads, this could be very dangerous for passing traffic, and expensive for farmers. With an 800 kg square bale, this is not a problem. Once they've been baled and wrapped, they stay put until they are collected – usually by the customers themselves.

### A man of many talents

Carsten Schulte took over the contracting business from his uncle in 1999 and has gradually expanded



The wrapper pivots to the right to pick up the square bales for wrapping.

it over the years. Today he employs five full-time staff and up to 15 casual workers. As well as agricultural services, including drilling, forage work, and harvesting from May to September, he also does forestry work. Carsten Schulte owns several forestry tractors on tracks of up to 700hp which operate powerful toppers. These are contracted out to customers all over Germany to clear so-called "calamity areas" – forests that have been damaged by bark beetles – and prepare them for replanting. You can't help but be impressed when you watch these machines in action. As with the machinery he uses for silage making and other agricultural services, there are no half measures when it comes to his forestry equipment.

With three of his employees specialised in operating the forestry tractors, Carsten Schulte is free to drive the agricultural tractor or forage harvester as often as he can. His passion for modern agricultural machinery – such as the BiG Pack 1270 VC – shows no sign of diminishing even after a quarter of a century in this field. <<<



Contractor Carsten Schulte has gradually expanded his business over the last 25 years.

To ensure that the bales are completely airtight also at the edges, we apply six layers of chamber film.

Carsten Schulte, contractor



Making up to 40 bales per hour, the contractor is very happy with the baler's performance in the hilly terrain of Hochsauerland.

Working where other people go on holiday – a field with a view in Hochsauerland.



# Automated approach

KRONE and Lemken are working together to develop solutions to automate work on the fields. How is the project currently progressing? XtraBlatt asked Jan Horstmann, the Managing Director of Design & Development at KRONE and Burkhard Sagemüller, the Head of Development at Lemken.



We fitted a trailer to the VTE enabling a standard tractor to tow it on the road just like a trailer.

**Jan Horstmann, Managing Director of Design & Development at KRONE**

Initial ideas about the "process unit" ("Verfahrenstechnischen Einheit" (VTE)) were first exchanged in 2018 explains Jan Horstmann, when we met him along with Burkhard Sagemüller for a meeting at the Tec-Center – the KRONE development centre in Spelle, Germany. The first VTE was tested in 2021 and in 2022 we presented our cooperation to the public by introducing two further prototypes developed by the brand – Combined Powers – that we had developed together and for which 22 people from KRONE and Lemken now work. The main objective of the project is to achieve the automated processing of fields, with KRONE concentrating on all of the work processes relating to forage harvesting, such as mowing, tedding and swathing. Lemken, on the other hand, is focusing on field work using grubbers and disc harrows, sowing and the mechanical protection of plants using row hoes.

**XtraBlatt:** The VTE was presented to the public for the first time at the start of 2022. What has happened to the project since then?

**Jan Horstmann:** Following the official presentation of our prototypes in May 2022, we have completed approx. 1500 hours of automated work with both machines on practice fields around Germany. We tested different work processes that provided us with positive results, ensuring that nothing will prevent us from testing this technology further.

**Burkhard Sagemüller:** Just to clarify, we are talking about the "process unit". This unit is made up of the automated towing vehicle as well as the "intelligent" accessory equipment, such as a mower or grubber with "additional equipment". It must be integrated into the entire work process to ensure the automated machine combination can work sensibly and reliably on the field. This is the automated process unit (VTA = "Verfahrenstechnische Automatisierung") for which there are also different project teams at KRONE and Lemken. What is sensible and what is absolutely necessary when using accessory equipment in automated combinations? These are questions that the



To simplify transport on the road, a drawbar was developed with which the VTE can be towed by a tractor just like a trailer.

teams are asking themselves. For example, if the grubber becomes blocked during operation, the vehicle must not just continue driving. To prevent this from happening, we must determine which additional sensors and actuators are required to ensure the smart implement can be operated continuously and safely in practice.

**XtraBlatt:** Did the technology function as planned in practice or were there any technical setbacks?

**Horstmann:** Let's start with the positive points. The preliminary planning and driving along the preplanned tracks worked perfectly during testing. The steering system and machine performance were also convincing. When it came to the environment recognition system, we were able to learn a lot about the detection of moving and stationary obstacles, such as animals that can confuse the environment recognition system. Impaired visibility caused by dust formation is also a challenge that we are constantly improving in the Project Development department. We are currently improving the systems at a test site near Osnabrück, where we are working with the German Research Centre for Artificial Intelligence (DFKI) to train our sensor technology and software on a slide system 24 h a day. We are definitely on the right path and will focus on points raised

We are now focusing on further developing the intelligent accessory equipment that completes the work process.

**Burkhard Sagemüller, Head of Development at Lemken**



during the practice runs and ones that came to light in the feedback from the pilot operations of our machines.

**XtraBlatt: Such as?**

**Horstmann:** We took the low loader out on the road quite a lot. When mowing, you have to switch between surfaces relatively frequently. This means that the machine has to be loaded and unloaded every time which will take even an experienced person 20 to 30 minutes. This is one of the main points that was criticised during the pilot operations of our machines. This why we developed a solution to legally transport the machines, including the accessory equipment, on roads without the low loader.

**XtraBlatt: How does that work?**

**Horstmann:** We fitted a trailer to the VTE enabling a standard tractor to tow it on the road just like a trailer. During this process, the front axle is steered mechanically while the rear is steered hydraulically. We are also working on a second attachment point on the VTE. To date, there has been one lifting unit and one PTO shaft. On the next generation, the VTE 3.0, both sides of the machine will have attachment points and will then also be able to use machine combinations, such as a triple mower or sowing machine combinations.

**Sagemüller:** When it comes to the VTE, we believe we are very close to having a series machine. We are now focusing on further developing the intelligent accessory equipment that completes the work process.

**Horstmann:** Lemken and KRONE are also collaborating on the development of the sensors and software for the accessory equipment. However, the work processes are very different, which is why the two companies are working on the automation separately. At KRONE, for example, we are developing the automatic height adjustment of the mower. We are also working on a damage detection system for the mower blades. These

are techniques that are definitely required for automated areas of application.

**Sagemüller:** We presented the initial results on monitoring the work machines at the Agritechnica trade fair.

**Horstmann:** The aim is to develop technologies with which standard accessory equipment can be fitted or retrofitted to help drivers set up and monitor work machines. At KRONE, we are focussing on monitoring the rotational speeds, vibrations and torque on grassland machines using sensors.

**Sagemüller:** We, on the other hand, are concentrating on imaging sensors and the evaluation of data using artificial intelligence. The software continuously improves independently during the work process. At Lemken, we are benefitting from the skills of a company based in the Netherlands that we are working with and which is focusing on controlling mechanical hacking techniques. By focusing on this automated process, we are continuously developing new ideas, some of which have resulted in patents. The VTE has led to nearly 20 patent applications to date.

**XtraBlatt: What do the users, who have seen the VTE in use, have to say?**

**Horstmann:** At first they are sceptical about what the technology can achieve in practice. What is the commissioning process like? How does the machines operate in the first two rows and what happens at the headland? If that all works, this is followed by questions on planning the work, operation and the environment recognition system. Of course, it also always depends on who you talk to. Operations managers are very interested in the technology because they are finding it increasingly difficult to find qualified personnel. Automated technology could thus be a solution.

**XtraBlatt: What about the drivers?**

**Horstmann:** They have quite a critical view of the machine. However, the fact is that we do

not want to and will not replace personnel with automated technology. However, one thing is clear, automated technology will change the way in which staff work. In future, we will need fewer standard machine drivers and will instead need trained specialists who are able to place several automated units into operation and monitor them. Complex tasks, such as driving on roads to switch fields and the corresponding supply logistics will continue to be completed by tractors with a driver. Automated technology will not be able to deliver this for quite some time.

**Sagemüller:** Our 230 horsepower machines can be used with 3 m to 6 m wide tillage equipment – not 24/7 but 15 h a day is quite conceivable. Especially for monotonous work, such as stubble tillage for example, this will provide an efficient alternative to companies that have a lack of staff or time. This work could be automated in future. However, to be able to use the technology efficiently and within a sensible budget, we must offer customers as many application options as possible. At Lemken, we are particularly thinking about the preparation of seedbeds, as well as standard and precision seeding.

**XtraBlatt: The number of sensors and actuators on smart accessory equipment is increasing. Will the ISOBUS not reach its data transmission limit at some point? Do you then not run the risk of manufacturers launching their own isolated BUS applications on the market?**

**Sagemüller:** From a customer's perspective this would of course be fatal. We are therefore actively working on a new ISOBUS standard with the Agricultural Industry Electronics Foundation (AEF). This standard will be a high-speed ISOBUS and will be significantly more powerful. However, it will also require different hardware, such as new



plugs. The AEF already presented the high-speed ISOBUS at the Agritechnica trade fair.

**XtraBlatt: When will the technology be implemented in practice in greater numbers?**

**Horstmann:** We believe that series machines will be in operation in five years time. <<<

While KRONE is working on the automation of forage harvesting, Lemken is focusing on field work, sowing and the mechanical protection of plants.



At a test field in the grounds of Gut Arenshorst manor, KRONE and Lemken are working with the DFKI to research the environmental perception of automated agricultural machinery.

## »» Film about VTE



Scan this QR code or go to [kurzelinks.de/VTE](https://kurzelinks.de/VTE) to view a film that explains the VTE concept in more detail.

# Straw bedding for happy pigs

The Albersmeier family have been finishing pigs to the “Strohwohl” scheme since 2018. Their experience shows that a happy pig does not necessarily have to be an organic pig. For their happy pigs, they have the round baler churn out around 4,500 bales of straw every year.



Visitors to the Albersmeier farm in Hüttinghausen, located in secluded countryside in South Westphalia are met by a sight that could have come straight from a children's picture-book: sheep, donkeys and alpacas grazing contentedly in the paddock, chickens and geese waddling in leisurely fashion across the yard, pigs emitting loud but playful squeals – and the typical farmyard aromas.

## A new era

Klaus Albersmeier took over from his father in 1986, the fourth generation of his family to own and run the farm. In 2013, his second wife Marianne brought a breath of fresh air and new ideas to Hüttinghausen. It was the dawn of a new era. “I had no idea about farming,” she says. “But I thought: Oh, it's not as hard as it's often made out to be. However, I had questions of course, and I had different ideas.” This is therefore also the story of a Green Party voter and of a typical farmer. Klaus Albersmeier went along with these ideas and was obviously keen for change: “To a certain extent, I also see it as part of my responsibilities. Animal welfare, especially in pig farming, became a major issue a few years ago. At the time, the German government commissioned a study which came to the conclusion that conventional pig farming in the way it was being run had no long-term future. That set me thinking, and I was also curious about how things could be done differently. The time at which all of this was happening coincided with the arrival of a new life partner who didn't come from this agricultural bubble which serves as a comfort zone for us farmers.”



Other animals, such as donkeys and a herd of alpacas, enliven the scene on the Albersmeier farm.



Klaus Albersmeier (first on the right) and Marianne Albersmeier, together with farm manager Till Kranepuhl

Because of the remote location of their farm, the Albersmeiers were also able to experiment. They let their pigs go outside and saw that it worked well. In 2018 and after a two-year trial period, the couple took the decision to invest €1.5 million and to completely reconfigure the farm. The original stalls for 5000 finishing pigs became 3500 places on straw bedding.

## Strohwohl brand name

Since then, the pigs have been sold under the brand ‘Strohwohl’ which means ‘well-being on straw’ – a programme that was developed together with the Rewe retail chain and Westfleisch slaughterhouse. The Albersmeiers have signed a five-year contract with Rewe.

The Strohwohl brand stands for: 100% straw rearing, double the space, toys to keep the animals occupied, locally grown GMO-free feed and short transportation distances. The piglets are sourced exclusively from a regular partner farm no more than a ten-minute drive away, where the piglets are also kept on straw after weaning. The abattoir is also nearby, just 20 kilometres away. »»»





The Albersmeiers use around 4,500 bales of straw per year on their pig farm.

For the first three years, the Albersmeier farm was a pilot project within the Rewe Strohwohl scheme, the products of which are now sold in more than 130 Rewe stores throughout North Rhine-Westphalia and Rhineland-Palatinate. Each week, the Albersmeier farm sends around 150 pigs in two deliveries to the Westfleisch abattoir, from where the meat is sent on to Rewe West. Klaus Albersmeier: "In the meantime, Rewe has brought other farmers on board and around 350 "straw pigs" are now slaughtered every week."

The animals are slaughtered at around 24 weeks, which is later than in conventional pig finishing, and they are also heavier at a live weight of 150 kilos. Klaus Albersmeier is convinced that this factor and the much shorter transportation dis-

tance have a positive effect on the meat quality: "Trials with different breed crosses, such as Duroc boars, have not resulted in any further perceptible improvement in meat quality for us – at least in sensory tests."

Due to the higher slaughter weight and the slightly higher fat content, however, the deliveries no longer fit in with the abattoir's payment system: "We therefore get a fixed price, which is based on the daily VEZG association price and is guaranteed to be at least €1.50/kg. We are paid a surcharge for the extra costs we incur for providing the straw bedding. We have done well with this over the last four years and have managed quite well despite the market pressures in the pig rearing sector."



The sheds have two separate outdoor areas, which are also littered with straw and mucked out in turn.

The air-conditioned stalls are ingeniously configured, with covered runs on two sides of the shed. These are mucked out and littered with fresh straw on a weekly basis.

### 4500 round bales of straw

On average, around 4500 bales of straw are required to absorb the five to six thousand tonnes of manure each year. These bales are stored dry in a newly built barn on the periphery of the farm. Around 20% of the straw comes from Albersmeiers' own 125 hectares of arable land, with the majority being baled on land belonging to colleagues in the neighbourhood, and a small amount being purchased pre-baled.

Since November 2022, farm manager Till Kranepuhl has been in charge of the pig finishing operation as well as the entire field work. He is assisted by three full-time staff and three apprentices. "It is not our philosophy to work all our lives, and we would eventually like to spend our time doing other things," says Klaus Albersmeier. "At the same time, however, we don't want to see everything we have built up here simply vanish one day. That's why we decided to hire someone who can slowly grow into the management role. Till is a 100% fit for the farm, both in a professional capacity and also on a personal level."

But back to the subject of straw. There are actually no special requirements for this commodity, except that it should be harvested as dry and fungus-free as possible. "The type of straw – whether wheat, rye or barley – doesn't matter," explains Klaus.

This year, the farm invested in a Krone round baler for harvesting the straw. The variable chamber produces bales in diameters from 0.8 to 1.9 metres. Farm manager Till Kranepuhl, who also runs a small contracting business, was keen that a powerful machine be purchased: "In my opinion, the Krone VariPack Plus is currently the most powerful baler on the market. And almost everything runs automatically." He particularly likes the roll chute on the side for easy net refills. The VariPack Plus presses straw for the farm's own needs as well as hay on a contract basis.

### Other business interests

In addition to the Strohwohl pigs, the Albersmeiers are also actively pursuing other business opportunities, such as a 380kW solar energy plant, and retail Iberico pork. This latter outlet experienced a boom during the pandemic but is currently languishing in the doldrums – a complaint that we are often hearing from direct marketers – and so the herd was reduced from an initial 120 to 30 animals.



A freshly littered area with happy pigs. Seen here on the left: The KA-Rondell drinker system designed by Klaus Albersmeier.

They also run a mobile barbecue truck which can be booked for parties and celebrations, with meat products from the Iberico pig herd. Of course, this is also rolled out for farm tours or the biennial Kultur auf dem Hof (Culture on the Farm) event. "We have several hundred people visiting our farm every year," says Marianne Albersmeier with evident pride. She is responsible for the farm's public relations and marketing.

The Albersmeier family recently opened two new holiday apartments and a B&B room to cater for the huge demand for relaxing farm breaks in a beautiful rural setting. This too is part of the public relations work that is so important for German agriculture. And what better sort of country break could you have than one with a view of contented Strohwohl pigs? »»»

### »»» Farm owner Klaus Albersmeier

Klaus Albersmeier is constantly striving to improve the conditions in which his animals are kept and has even designed his own water trough for pigs. The patented KA-Rondell allows three to five pigs to drink simultaneously from an open area in a species-appropriate manner. At the same time, an aqua level cuts water consumption by around 30% and reduces the amount of slurry by up to 40%. The system can be extended to include a rubbing pole, play ropes or roughage basket. You can find out more about this and the Albersmeier farm at [www.hof-albersmeier.de](http://www.hof-albersmeier.de)

GREEN TEUTO SYSTEMTECHNIK

# Auto pilot

KRONE is working with manufacturing company Green Teuto Systemtechnik (GTS) setting new milestones for production robotics in the world of agricultural technology. The group of companies has also launched an automation pilot project. XtraBlatt visited the site and had the concept explained to them.



Phase 1 consisting of a production hall for welded component groups has been completed on the nearly 20 ha large plot. The construction of phase 2 consisting of a completely new painting plant started in the summer of 2023.

Imagine the following: steel, wheels, cables, hydraulic lines and various other components are transported into the front of a workshop, you end up with a fully assembled machine at the other end and the entire production process is fully automated without a single person laying a finger on it. A utopian idea, perhaps? Not quite, because in the near future this vision will become a reality or at least at one of the sites of the KRONE Group. More specifically, at Green Teuto Systemtechnik (GTS) based in Ibbenbüren near Osnabrück, Germany. On the nearly 20 ha plot, an approx. 12,300 m<sup>2</sup> large hall was the first of three construction phases to be completed during the summer of 2022. This hall has since been used to produce complex welded component groups. The company is thus sort of operating as an internal supplier for the agricultural technology sector and in future will also have opportunities in the KRONE commercial vehicles sector.

"In doing so, we are focusing on highly modern, smart and sustainable production concepts and processes," emphasises Jochen Roling, the Managing Director of GTS. However, this northern German, down-to-earth explanation does not really reflect the technical revolution that this setup actually has to offer. The term "state-of-the-art" really is not an exaggeration as he is convinced there is nothing comparable in the European agricultural technology sector. This ultimately makes everyone more curious to know more.

## Fully integrated plant

To provide a better overview, the Managing Director first provides a brief explanation of the construction phases and timeline for implementation. Phase 1 comprises the existing plant, the core task of which is the production of welded

component groups. The installation of the last production technology for this construction phase was started in November. When completed in February 2024, production and capacity will be ramped up incrementally. The next objective, is to start operating a two shift system with up to 100 employees from February 2024 onwards.

Phase 2 consists of a completely new painting plant. Construction of the approx. 10,000 m<sup>2</sup> large hall started in the summer of 2023. By the end of year, the outer body of the hall should be complete. The interior construction, test runs and commissioning are planned for the autumn of 2024 and from 2025 onwards the system should be fully operational. Last but not least, phase 3 of the project, that consists of a hall for complete device assembly, was granted planning approval in the summer. "The project is expected to be implemented at the start of 2024, although this will be dependent on the development of the market and economic situation in the agricultural technology sector. If everything goes as hoped, we will ideally be able to start with the new assembly here in Ibbenbüren during the second quarter of 2025," explains Jochen Roling.

## Self-learning system

So what is so special about automation? After all, a team of 100 people is not a completely deserted building – however, this is not the ultimate goal explains the Managing Director with a grin. "Of course, a plant cannot operate without any people. However, our aim is to automate the actual production process as much as possible," he adds and continues with his explanation of the IT infrastructure. »»»



**Before components are installed by the supplier in the Production department, the quality must be checked as part of the incoming goods inspection. At GTS, this is completed in real-time using Visometry – a mobile augmented reality system.**



Pure precision when the robots weld the rotor shafts of the loading and forage transport wagons. The highlight of automated production is an automated quality assurance process and self-learning total system.



## »» Profile

Jochen Roling is the Managing Director of GTS Green Teuto Systemtechnik in Ibbenbüren.

KRONE has collaborated with a research institute from RWTH Aachen University to develop a completely new event-based IT infrastructure. The core of the system is based on data brokers that record all of the data relating to every single production step and every single production facility right through to the final inspection and can then make this available to all of the other applications and analyses.

This all sounds theoretical but becomes clear when explained on a specific example: A request to weld a rake bar is received by the system. The prefabricated steel parts are picked from the warehouse and transferred to an automated transport unit. This unit then transfers the material from one production step to the next. During this process, other robots insert and remove it from the individual production steps. The actual welding is also completed by a robot. The corresponding rake bar is thus commissioned, tack welded, welded, machined and so on through to the final inspection when the produced welded component group is measured against the design data.

"The total system is able to control production based on events. Each subsystem has the ability to evaluate the previous events, i.e. the completed tasks as well as the production-related data that has been recorded. This can occur as every individual step is documented digitally, so that the voltages, currents or exact position of the seam, for example, are recorded during the welding process," explains Jochen Roling. When it comes to the seam, a system setter would have previously programmed a welding robot based on 2D drawings, while in future the 3D information about the required seams will automatically be entered in the system. This significantly reduces the sources of error so that 100% of all seams are automatically defined, detected and systematically recorded in their quality.

This point is particularly important when it comes to KRONE quality standards. Components are measured automatically and the results are subjected to a target/actual comparison using saved production data, such as the design specifications. In the event of any issues, it is not just the workpiece that has to be reworked, it is just as important that the automatic learning processes of the system, which in turn feed back into the production steps and design, are reworked. "The ultimate aim is not only to automate production but to develop a self-learning system where the processes have a repetitive accuracy of practically 100% – which will all be down to this technical revolution," highlights Jochen Roling.

## Changing the world of work

Jochen Roling continues to explain that based on these facts, a logical conclusion is that in future this project will gradually be rolled out to the Group's other production locations, meaning that GTS is playing a leading role in the development of "Production 4.0". In this context, it is very important for him to emphasise that this process is definitely not designed to reduce the number of employees as far as possible but actually quite the contrary. The lack of specialists, which is already glaringly obvious, would mean that the KRONE Group would not be able to realise any further growth because of limited capacity. Achieving more with the existing team, compensating for the consequences of demographic change and increasing the competitive value creation at the site in Germany are all driving factors for this development."

Jochen Roling also believes that another advantage is that the, in part, physically demanding jobs in the part production and final assembly departments are literally being made easier. It will thus also be possible to increase the proportion of female employees in the Production department and thanks to increased automation levels, employees will be able to learn to complete technically more complex activities using existing control systems without having to first gain special qualifications. This explanation incidentally also outlines that the automation process will not end with the pre-production process but will also be implemented during final assembly. Although, where, how and to what extent purely automated systems or hybrid human/robot collaborations will make sense has not been finalised. In this context, GTS will take on a pilot function when it comes to the automation of the KRONE Group," summarises Jochen Roling.

## BiG X

# Blade sharpener scoops DLG Silver Medal

The new and patented "Blade sharpener on forage harvesters that requires no manual adjustment" was awarded a Silver Medal by the German Agricultural Society (DLG) at Agritechnica last November. This novel blade sharpener completes 2200 grinding cycles without the grinding stone ever needing manual adjusting. As such, the sharpener has five times longer service intervals than traditional sharpening systems.

The technology is based on a new development where the grinding stone has an integral telescoping thread. Thanks to its innovative attachment, the stone's entire surface area is available for grinding – unlike traditional attachment systems where only 40% to 55% of the surface area is actually available for grinding. An increased grinding surface naturally reduces surface wear and increases its service life. More than state of the art, this grinding assembly is sealed from the ingress of debris and as such protected against malfunction or failure. Another

advantage of this new sharpener is its positive effect on the chopping quality, because the shear bar on the chopping drum is mounted not only in the middle but also at a consistent distance from the two rows of blades. It is this small detail

that makes for a significant improvement of the quality of chop.



## Swadro TC 1250

# Raking at greater comfort

Swadro TC 1250 is a four-rotor rake that delivers working widths from 9.8 to 12.5 metres. The machine which has proved its worth extremely well in contracting work, is now also available as Swadro TC 1250 Plus version. Compared with the standard machine where the hydraulic functions are selected from the Krone control box, this new Plus model features the new PreSelect Digital function which links up to the Isobus socket on the tractor so the operator can view a selected function on the Isobus terminal. After the function has been selected on the screen, it is executed by the tractor spools.

Apart from that, PreSelect Digital also allows operators to select the function and operate the spool from the AUX buttons on the tractor's Isobus-compatible drive lever. Hence operators can execute all machine functions from the joystick and without moving their hand. In addition, the new operating concept allows them to set up Swadro TC 1250 Plus much faster. For example, the rotor height is no longer set manually but electrically and from the cab-based terminal; and each rotor can be set to a different working height. At the same time, it is possible to lift

out each of the four Plus rotors individually for optimum results in awkward fields.



CONTRACTOR TOBIASEN, RIBE, DENMARK

# Different dimension of forage harvesting

Controlled traffic farming – working fields along fixed tracks – is well established in the arable farming sector. In Denmark, this approach is also being used for grassland management. Contractor Hans Tobiasen has already been using this approach for several years and has had a very positive experience.



The town of Ribe, is approx. 30 km North of the German/Danish border on the West coast of Denmark. There is a mix of agricultural industries in this area. In addition to arable farming on excellent marsh sites, there is particularly rich grassland for livestock farms to use. The headquarters of contractor Tobiasen are based directly outside the gates to the town. The company is managed by brothers Christian and Filip Tobiasen and their mother, Jette. "There are two parts to our business. One which provides civil engineering work and has eight employees. However, the considerably more profitable part of the business is our agricultural contracting business with a total of 22 employees," explains Christian Tobiasen.

## Nearly always complete

Most of their customers are cattle farms for which the contractor harvests the forage of grass and maize in complete harvesting chains. "To a lesser extent, the farms also grow cereals, which we also sow and harvest for them," adds Christian Tobiasen. The size of the herds at these farms varies between 300 and 600 animals. "Over the



Contractor Hans Tobiasen uses three KRONE BiG X for the chopping process – two 1180s and one 680.

last few years, there has been quite a considerable amount of structural change. Some of the farms have abandoned the industry. The sites have been taken over by those who have remained," adds Christian Tobiasen explaining their own customer structure and continues: "However, overall there is lack of space and the farms are thus obliged to manage the land that is available to them more efficiently. The same applies within the company. The farms focus all of their attention on their livestock and on optimising the efficiency of the milk production process." For contractor Tobiasen, this in turn means more work in the forage harvesting and arable farming sectors as these farms outsource all of their work to the service provider. "The customers want to harvest the best quality forage at the right time. And they require our efficient processes to achieve this," explains Christian Tobiasen.

For most customers, the contractor now completes the entire harvesting chain. This means that the Tobiasen team takes on the mowing, swath, chopping and compressing. "The trend is increasingly moving towards this division of labour, as this enables farmers to reduce the total costs for each produced kilogramme of milk. Using our technology we harvest a far higher quality of silage than individual farmers could achieve on their own. We start at the best possible time and very efficiently harvest the forage and wrap it in film in the shortest amount of time," explains the contractor, backing the statement up with the following figures: "Working with one harvesting chain, we are able to chop up to 240 ha of grass in one day. We complete the harvest with three harvesters – two KRONE BiG X 1180 and one BiG X 680." On average, we cut the grass five to six times per year. >>>

We harvest 18 to 25 ha per hour.

Christian Tobiasen, contractor



A total of 30 employees work for Tobiasen completing civil engineering work in addition to agricultural services.

## Launched in 2013

In 2013, contractor Tobiasen launched controlled traffic farming (CTF). "A key customer approached us with the idea to only drive along specified tracks on the grassland. The contractor recalls that the farmer wanted the contractor to only work along these tracks with the mower, rake and manure systems, continuing to explain: "During the first

year we had some problems navigating the plots, which, at the time, was mainly down to the fact that the correction systems of the automatic steering systems were not 100% reliable. We have now resolved this problem. All of the machines are connected online via a data cloud and can access the same tracks." A RTK system with an accuracy of 2 cm is being used.

Our customers focus all of their attention on their livestock and on optimising the efficiency of the milk production process.

Christian Tobiasen, contractor

Managing the contracting business as a family (from left to right): Mother, Jette Tobiasen, and her children Ida, Christian and Filip.



The mowing process is completed with wide spreading on one side, which means that the relevant outer width of the mower is moved to the middle. Swathing, amongst other things, is then completed with the KRONE Swadro TC 1570 four-rotor rake. "This means that we can cover more than 20 metres in one swath." Christian Tobiasen is convinced that this covers a large enough quantity that they can make good use of their KRONE BiG X 1180 in the grass with its 3.8 m wide pick-ups. The grass is chopped to 6 mm to 8 mm.

The process has now become well established amongst the contractor's customers as the results speak for themselves. "Our technology enables us work a lot more efficiently. This means that the customer benefits from the fact that we can work faster as we nearly always invoice based on time. We, on the other hand, can make better use of our technology," Christian Tobiasen continues to explain. For a harvesting chain consisting of two drivers, one harvester and two wheel loaders for the rolling process, the contractor charges approx. €1000 per hour. At first, this sounds like a very large sum but Christian Tobiasen puts this into perspective by adding: "we harvest 18 ha to 25 ha per hour."

## Increasing yields

When it comes to yields, plots at difficult locations will generate more using CTF in comparison to fields using standard processes. The fact that, except for the tracks, the land is less densely populated ensures that the grass is of a higher quality. "The farmers who use this process also look after their grassland better. As soon as we have completed the harvest, slurry is spread across the plots to guarantee that nutrients are available for the new grass," explains Christian Tobiasen. To ensure the tracks are not destroyed, the harvest is not completed if the ground is not solid enough. Once established, the tracks remain in place for five years when it is time to plough the grassland and sow it.

"We always try and find the right time for the harvest, so that we do not cause any damage to the plots and their tracks. That is not always easy with our changeable weather influenced by the coastline. However, we are very efficient and manage to complete a full chopping process for all of our customers within one and a half weeks," explains the contractor confidently. Volvo wheel loaders and tractors with double tyres are used for the rolling process. To be able to guarantee a sufficient level of compression, two roller vehicles are required on the silage especially if the BiG X 1180 is being used.



By using CTF to forage harvest, enormous harvesting yields of up to 25 ha per hour are achieved as a working width of more than 20 m is placed in one swath.

## Digitalisation is continuously progressing

In the meantime, the first customers are now demanding yield maps including dry matter data relating to the grass silage harvest. The contractor Tobiasen records this data using NIRS sensors on the harvester and currently still provides customers with maps free of charge. "We assume that the demand for this will continue to increase. The preparation and provision of these maps can then be developed into a new business model for us. Our sensors can also be used during the slurry spreading process. If customers start to request this information, it could become an interesting opportunity for us over the coming years," states Christian Tobiasen looking to the future and concluding:

"Contractors in Denmark have a bright future ahead of them. We have witnessed that our growing agricultural businesses are increasingly only focusing on the production of milk. Other tasks are increasingly being outsourced to us. We provide the best forage, a prerequisite for achieving an optimum process from the trough through to the end product – milk." »»»

## »»» What is controlled traffic farming?

Controlled Traffic Farming (CTF) is a management tool used to manage agricultural land in which all of the machines drive along a specifically defined track system in the fields. This results in significantly less of the surface being overrun by the machines. Less soil compaction, more stable yields and better water flow conditions are all reasons for using this agricultural system. A prerequisite is the accurate planning of the tracks and strict adherence to them when driving on the field. Automatic steering systems in the machines support this process.

# Let's go west!

Krone North America recently celebrated its 50th anniversary. The early years of KNA were not without their difficulties, but this period led on to a success story that has made North America one of the most important export markets for Krone today. An update from Dietz Lankhorst, Managing Director of KNA.



**M**aking the move “across the pond” may not have been quite as perilous as the voyage of the Mayflower in the early 17th century, but it would be disingenuous to claim that anyone knew in advance what the following years would entail. A fresh start in a huge country where organisational structures, mentalities and the demands on agricultural equipment are completely different from those in Germany certainly warranted a cautious approach; and it was decided that the company should not embark on this adventure alone, but rather in partnership with others. In 1973, three medium-sized manufacturers – Krone, Mengele and Niemeyer – with similar capabilities and interests as well as a good relationship at owner level came together to form a joint venture, KMN Modern Farm Equipment Inc., at the time headquartered in West Memphis.

However, the initial euphoria faded quite quickly for a variety of reasons, the most acute of which was the slide of US agriculture into a deep, sustained recession in the second half of the 1970s. This not only led to tectonic structural changes in the US agricultural machinery industry, but also put the market newcomers from “Good Ole Germany” under extreme pressure. Exacerbated by management errors at the sales and distribution company, the North American venture seemed doomed to failure in the mid-1980s.

## The Rusty Fowler era

However, 1987 can be seen as a clear turning point and the beginning of a sustained change for the better. This was when Rusty Fowler, who had spent the 15 previous years working in management at Case IH, was appointed Managing Director of KMN. Thanks to his knowledge of the market and customers, his prodigious energy and perseverance, he managed to reorganise the company systematically and gradually built up a new team and, above all, succeeded in expanding the sales network. This included not only setting up a dealer network but also opening branches under the company name to give the brand a market presence. The first few years were discouraging in terms of turnover and profits, but by the beginning of the 1990s, the company had turned a corner. Sales doubled within five years to more than 11 million US dollars, equivalent to just under 17.5 million Deutschmarks at the time and around €8.8 million at today's prices.

The year 2000 brought another turning point – the acquisition of Niemeyer by Vogel & Noot also ended the joint involvement in North America, with Krone becoming the sole partner and KMN now being rebranded KNA – Krone North America. This made it possible to implement with even

One of our challenges as a green fodder and straw harvesting specialist is to secure market access and tap the potential even better.

**Dietz Lankhorst, Managing Director KNA**

greater speed and consistency the changes that were necessary for Krone equipment to realise its potential in the US market. Wilhelm Voss, Managing Director of Sales and Marketing at Maschinenfabrik Krone, was at Rusty Fowler's side in the capacity of Co-Managing Director. They were supported by Krone Export Manager Manu Ruhara, the third member of a triumvirate that harmonised perfectly both at personal and professional level and which was certainly one of the main driving forces behind the success story of the coming years.

The expansion of the Krone product range to include the BiG Line (consisting primarily of the high-capacity BiG M mower, the BiG X forage harvester and the BiG Pack square baler) also proved to be a shot in the arm. From the perspective of the German market at the time, the products of the BiG Line appeared to be somewhat overdimensioned, but they were ideally suited to the requirements of North American farmers with their desire to maximise output per acre without compromising on forage quality. And although the learning curves in terms of machine design and service support were initially very steep, the BiG Line considerably boosted business for KNA. By comparison, in California, square balers are expected to make as many as 40,000 bales a year – a huge challenge for the hardware, but one that provided a significant impetus for Krone R&D as a whole. In terms of operating conditions and machine utilisation, servicing the North American market is certainly one of the most demanding undertakings in the world. By 2018, Rusty Fowler's retirement year and the arrival of his successor Dietz Lankhorst, KNA's turnover had increased to almost 100 million US dollars, or around 90 million euros at the prevailing exchange rate – more than ten times that of 1992. »»»



## »»» Profile

**Dietz Lankhorst** has been Managing Director of Krone North America for the past five years. During this time, the company has succeeded in almost doubling its sales figures.

In California and elsewhere, square balers churn out up to 40,000 bales per year.



The BiG M comes into its own on large expanses.



### Well established

In addition to the headquarters in Olive Branch (Greater Memphis), KNA today has five other branch outlets in the North American market, two of which are located in Wisconsin and three in California. The main backbone of our sales and service departments, however, is formed by around 350 dealers in the USA and Canada, approximately 200 of which are significant sales drivers. Dietz Lankhorst, the current Managing Director, explains: "Our product range is generally very lucrative for dealers, but it always depends on the tractor brand they represent. Some of the so-called "full liners" put especially heavy pressure

on their dealers in this respect. One of our current and future challenges as a green forage and straw harvesting specialist is therefore to secure the access to the market, provide the service and exploit the business potential more effectively than before."

According to Dietz Lankhorst, a market share for square balers of as much as 65% in the Imperial Valley of Southern California – a major forage-growing state in the USA – shows that this can be done very successfully. The forage and straw harvesting business in the western states is dominated by "commercials", i.e. large-scale farmers and contractors. In the dairy regions in the northern states, farm structures are usually mixed, a fact that opens up sales opportunities for Krone's entire machine and model range. By comparison, the south is the domain of so-called "core" forage harvesting equipment, machines, i.e. traditional and small haylage machines: "Much to the astonishment of European visitors, there are still many smaller farms in this part of the country, some of which are even run on a part-time basis. Here, the sales potential of the BiG Line machines is very limited," says Dietz Lankhorst.


The North American market for forage harvesters absorbs around 600-650 machines per year, which may seem small compared to a market volume of 400-450 machines in Germany alone: "Yet unlike the situation in Germany, forage harvesters are heavily used in North America. In the west, for example, the machines clock up between 1200 and 1800 drum hours per year, with peaks of up to 2400 hours. In the north, the average is 600 to 800 drum hours, with peaks of up to 1000 hours per machine and year. This is rarely if ever comparable with Western Europe."



### New impetus for KNA

And after the big anniversary celebrations at the end of October, what is the outlook for the future? Dietz Lankhorst doesn't have to think long about the answer: "Sales, service and marketing are still the key factors. At just under 180 million dollars, or around 171 million euros, we achieved our best turnover to date in the 2022/2023 financial year, but we still see a lot of room for improvement. For example, our core objectives include a major expansion of our dealer network throughout the entire sales region and, in particular, increasing our market share for round balers and of the BiG Pack, BiG X and BiG M."

Since mid-October, the KNA team has enjoyed the active support of Lars Pasedag, who was in charge of Krone sales in Australia, New Zealand and South East Asia. As Chief Operations Officer (COO), he is now responsible for sales, marketing and the service organisation in Memphis. His assignment gives Dietz Lankhorst the necessary freedom to set the strategic course, which may well involve production-related activities. He says he can't give any more specific details at the moment, but adds: "About five years ago, we started out assembling mowers, tedders and rakes here at KNA in order to offer our trade partners an additional service. After all, during the season the skilled dealer staff is usually out on service assignments and not available for assembling the machines." A mechanical

engineer by training as well as by vocation, Dietz Lankhorst was responsible for managing all the European plants at his former employer MTD. As he admits with a grin, production-related matters are still very close to his heart. In working to optimise the future production-related division of responsibilities between Spelle and Memphis, he is therefore very much playing to his professional strengths. Taken in combination with strategic development, this opens up another exciting chapter in the KNA story. 

Not everything in the USA is supersize. Especially in the southern states, a lot of farms are small by national standards as well as so-called "sundowners", i.e. part-time businesses.

Group photo of the KNA team together with Bernard Krone, Dr David Frink, Martin Eying, Jens Moormann-Schmitz and Heiner Brüning representing the German board on the occasion of the 50th anniversary celebrations.



A service truck US style – specifying even a crane for on-site servicing, which may involve several hundred kilometres of travel. It is therefore essential to bring along every single piece of equipment that could prove useful.

# News ticker



## DealerDay in France

Krone France organises the “DealerDay” event on a biennial basis. More than 350 visitors from the French Krone dealer network attended the 2023 gathering, where they learnt a lot about upcoming projects and new products.



## Suggestions rewarded

In the 2022/2023 financial year, the Krone workforce once again submitted plenty of suggestions for enhanced efficiency. These were evaluated by a committee which then awarded a total of 16 cash and non-cash prizes in recognition.



## More news

Current Krone press releases can be found by scanning the QR code or visiting [www.kurzlinks.de/Pressemitteilungen](http://www.kurzlinks.de/Pressemitteilungen).



## Grassland Group Chairman

Sueleyman Erekdı, who works in strategic market analysis at Krone, was unanimously elected chair of the Grassland Group within the European agricultural machinery manufacturers' umbrella organisation CEMA.



## Keen runners

The 23rd Summer Night Run that is organised by a Spelle bank took place in August. 55 entrants from Krone competed in this Summer Night Run, setting some highly respectable times in various categories with great individual and team performances.



## A crowd puller

This year's Rottalschau show in Karpfham attracted around 350,000 visitors. The Krone team and dealers made the most of this opportunity to conduct potential sales talks and secure initial deals.



## BiG X takes a long journey

Rather impressive: Here, a truck can be seen transporting a BiG X 630 – a demo machine from Krone France – across the Térénez Bridge in Brittany. The bridge, which connects the south and the north of the Finistère department, holds the world record for the longest span – 285 metres supported by 144 cable stays.



## Bouncy castle for hire

The AgriPark dealership in Upper Bavaria now has a bouncy castle in the shape of a BiG X (12 metres long, 9 metres wide and 6 metres high). It is available for hire to event organisers. Enquiries via e-mail at [info@agripark.de](mailto:info@agripark.de)



## The Krone look

The Krone graphics team within the Marketing department was given the opportunity to design a truck sporting the Krone look. The result is impressive!

## Machinery Ring Day

Around 350 experts, industry representatives and guests attended this year's Machinery Ring Day in Cologne which took as its theme “No energy transition without agriculture”. Krone led the discussions on the topic of bio-LNG.



## Museum make-over

The entire exterior façade of the Krone Museum in Spelle – including the entrance area – underwent renovation work in autumn, including new roller shutters, a fresh coat of paint and a redesigned forecourt.



## Anniversaries at LVD

No fewer than six LVD Bernard Krone employees celebrated anniversaries with the company last summer. Burkhard Meyer, Jens Rolinklammers, Andreas Wahlbrink, Michael Krieger and Dirk Burmester received the 25 years' service award. Stefan Stapper (seen here with Dorothee Renzelmann) was honoured for 40 years of service at Krone.



## Training Centre in Latin America

400 guests attended the recent opening of the “Training Centre Latin America” built for Brazilian importer Bouwman in collaboration with Krone. The occasion also marked the 50th anniversary of the founding of Bouwman and ten years of fruitful partnership with Krone.

# Sustainability works well

What impact does a loading and forage transport wagon have on the environmental footprint of an agricultural business? „One that should not be underestimated,” remarks farmer Tobias Endres. By using a new loading and forage transport wagon from the RX series he has been able to noticeably reduce this fuel consumption and thus his CO<sub>2</sub> emissions during the forage harvest.

**P**eak operation at the Hubertus farm in Irmtraut, Germany: In addition to dairy cattle operations in the Westerwald region, the fields are being cut for the third time. Farmer, Tobias Endres, relies on his own technology to ensure the harvest can be as flexible as possible. He uses a loading and forage transport wagon from the new RX series from KRONE and an older loading and forage transport wagon from the MX series.

The farm covers a total area of 260 ha, which is now being managed by the third generation – Tobias Endres and his wife Carolin Endres. The majority of the land comprises around 180 ha of grassland. And an additional roughly 40 ha each for maize and corn. Both are exclusively used to supplement the forage. The farm does not use feed additives such as soy meal. To still be able to provide high-quality protein feed to the cattle, the couple relies on residual materials from local rapeseed oil production, sugar beet pulp and their own corn.

**Fertile grassland:**  
High-quality forage grows on the Westerwald hills.

## RX reduces CO<sub>2</sub> footprint

They produce all of their own basic forage. The fields produce enough grass for all 300 dairy cattle as well as the farm's offspring. Enormous quantities of forage are required, as well as efficient technology to ensure such harvest quantities can be processed without any problems.

The pre-series model of the new RX loading and forage transport wagon has been used at Hubertushof farm since 2022. „The wagon has significantly increased our productivity and efficiency when harvesting forage, which in turn has reduced our fuel consumption and thus our CO<sub>2</sub> emissions,” states Tobias Endres praising the wagon. The diesel consumption of the RX loading and forage transport wagon combination is significantly lower than that of the twelve year old loading and forage transport wagon from the MX series.

The efficiency potential of the new loading and forage transport wagon from the RX series is mainly down to the wagon's overhauled high-performance cutting system. In this case, it is an „OptiGrass 28” that has 54 blades and achieves a theoretical cutting length of 28 mm – a length that is excellent for harvesting damp silage.

The optimised drive concept of the cutting system also contributes to reducing fuel consumption. The wide integral rotor is driven by a PowerBelt, which provides higher throughputs. PTO shaft outputs that are up to 25% higher can also be transferred on the RX loading and forage transport wagon. Another new feature: Both of the drive



**Low diesel consumption:** The short cut forage can be mixed particularly efficiently.

pulleys can be replaced easily and quickly, so that the unit can be adjusted to the relevant harvesting conditions, such as a voluminous swath during the first cut of the year and a smaller swath at the end of the season.

However, it is not just the loading and forage transport wagon that contributes to the fuel savings. A reduced fuel consumption has also been noticed when using a compacting tractor, especially during forage conditioning with a mixing vehicle. The compacting tractor benefits from the even unloading of the RX loading and forage transport wagon using two GD variant discharge rollers. They ensure the forage is unloaded evenly and also reduce the workload when distributing it in the clamp silo.



Tobias Endress not only values the RX for its excellent cutting quality, quiet running and reliability, but also for the folding top of the loading and forage transport wagon that can be operated from the tractor cabin.



Efficient forage harvesting: The new OptiGrass-28 cutting unit provides forage that is cut very short.



Can be adjusted to different harvesting conditions: The PowerBelt drive concept of the new RX loading and forage transport wagon.

The short cut grass also makes it easier to mix the forage. It also makes it easier for the animals to ingest and digest than longer cutting lengths. This in turn improves the health of the animals and subsequently also reduces the CO2 footprint.

### Excellent cutting quality

Tobias Endres, who has already completed three cuts this year with the new loading and forage transport wagon, particularly rates the excellent cutting quality of the cutting system. The quiet running, reliability and a few other features of the loading and forage transport wagon have also convinced the farmer. One of these features is the folding top of the loading and forage transport wagon ensuring that grass flying on to the roads is a thing of the past. The farmer certainly does not want to work without the loading and forage transport wagon again, especially because it can also be used as a forage transport wagon when harvesting maize.

The topic of sustainability is particularly important to the young farmer. Public discussions about CO2 emissions are increasingly focusing on



A good forage quality is the basis for a high milk output: The cows at Hubertushof farm in Rhineland-Palatinate produce an average of 32 l per day.



Supplies homogeneous forage: The integral rotor is the centrepiece of the new OptiGrass 28 rotor cutting unit.

agricultural businesses, especially fed and dairy cattle farms. Accordingly, many companies, as well as manufacturers of agricultural technology, are making an effort to implement strategies and products that will reduce CO2 emissions.

Tobias Endres and his father-in-law, Matthias Müller, keep a close eye on their carbon footprint. The business is using all available options to ensure carbon dioxide emissions are kept as low as possible. This starts with a photovoltaic system, that covers some of the power required by the business, and continues with measures such as pre-cooling the milk tank, which has significantly reduced the power consumption, and extends through to the use of efficient agricultural technology. „Every litre of diesel that we do not use, lowers our CO2 emissions and reduces the pressure on our operating costs,“ emphasises the Operations Manager Matthias Müller.

### Dairies want to be sustainable

One of the key factors for the business is having its own biogas facility. It was already constructed back in 2000 and completely renovated in 2016. Nowadays it supplies 75 kW of electric power and is fully operated with slurry and manure. The generated digestate is extracted at ground level using specially purchased technology and a drag-hose spreader. „This reduces any ammonia losses to a minimum,“ explains Matthias Müller happily. He has an exact overview of the company's CO2 emissions. „Two years ago we joined an European Innovation Partnership (EIP) project focusing on climate-smart agriculture. During this process, the experts calculated the footprint of our business in every detail,“ explains Matthias Müller. This has in turn given the business the opportunity to reduce the emission of climate-damaging greenhouse gases.

Although he indicates that this is not an end in itself. Some dairies now expect proof of the sustainability parameters from their milk suppliers. By implementing a variety of measures the Hubertushof farm has been able to significantly

reduce its emissions of greenhouse gases. „We calculated our footprint down to a litre of produced milk or kilogramme of meat and have meanwhile achieved a peak value compared to the rest of Germany,“ emphasises Tobias Endres. An output of 1.5 kg of CO2 per litre of milk or per kilogramme of meat is classified as normal. Good businesses can reduce their emissions to 1 kg. Hubertushof farm is in the top group with emissions of 700 g. Farmer Tobias Endres hopes to stay in this top group in the future. His new KRONE loading and forage transport wagon from the RX series will make a significant contribution towards this. <<<

Every litre of diesel that we do not use, lowers our CO2 emissions and reduces the pressure on our operating costs.

Matthias Müller, farmer

Engaged climate protector: Senior Manager Matthias Müller has consistently reduced the business' emissions of CO2.



Farmer Tobias Endres from Westerwald believes in reducing the emission of climate-damaging greenhouse gases.



Depending on the complexity of the product, there can be several years between the first design drawing and presentation of the finished product.

## MACHINE DESIGN

# Appearances count

Agricultural machines should be reliable and operate efficiently. However, it helps the sales pitch if the external appearance is also appealing. Berit Marzinzick and Frederika Hölscher, who are responsible for the design development within the Marketing Communications team of the KRONE machine factory and thus also play an active role in the design development of the machines, are well aware of this.

**W**e meet at the visitor centre in Spelle, Germany. Berit Marzinzick, Head of Marketing Communications, and Frederika Hölscher, Marketing Project Assistant for Machine Design, want to spend the day presenting a specific project to us and explaining how a machine at KRONE is designed. They are using the fifth generation of the large square baler BiG Pack as an example. Admittedly, it is not a brand new product. Understandably, the design of the machine of tomorrow is still top secret. During this meeting, we first and foremost hope to generally understand how designs are developed at KRONE.

### From a blank page ...

"We must first take a look at the PDP," says Berit Marzinzick starting the conversation and explaining: "This stands for the product development process. We will only start developing a new product following a comprehensive analysis of the market and requirements. We will only discuss the design once the first functional models have been developed." At this point, a decision has already been made as to whether the product so far corresponds to the original idea at the start of the development process and whether it should be developed further for series production.

The team will then meet with the product trio for a design kick-off meeting, i.e. the official start of the design development process. This committee is particular to KRONE – it is an institution for every product and every product group. It can make all of the decisions about the relevant product. This committee will include one person from the Product Marketing department, one from the Product Management department and a Product Manager who is responsible for the construction of the machine. Depending on the subject matter, the trio will seek support from other departments.

From a very early stage of the project, the trio responsible for the new machine that is being developed, has a document that already stipulates the required machine functions, its unique selling points (USP), the markets it is being developed for and, of course, which comparable competitive products are available. The design briefing is then derived from the marketing communication. This means that the design of the machine must be perfectly adjusted to the unique selling points. Although the guidelines must of course also be observed during this process. Ultimately, the appearance of the new machine must match the manufacturer's overall portfolio and be recognised as a KRONE machine. Legal requirements, such as ones relating to lighting, must of course also be observed.

### ... through to the drafts ...

"Generally, we then invite one of our design service providers, that specialise in work machines and devices, to the presentation of our project," says Frederika Hölscher explaining the process. Only once everyone in the meeting has the same understanding of what the future appearance of the machine should represent, will the service provider start to develop the first drafts. »»»

We know how important the design of products has now become for our customers and their employees.

**Berit Marzinzick, Head of Marketing Communication**



**Berit Marzinzick (right), Head of Marketing Communications, and Frederika Hölscher, Marketing Project Assistant for Machine Design, work on developing designs at KRONE.**

The result convinces from start to finish: The KRONE BiG Pack 1290 HDP can now be found in agricultural areas around the world.



An excellent example of increasing the benefits of users with intelligent design developments is the door-in-door principle on the BiG Pack 1290 HDP, which makes it significantly easier for the user to replace spools of twine.

By prioritising the unique selling points, the designer will develop different design lines from which one will then be jointly selected as the best fit for the product. If this is a new design, and depending on the complexity of the product, it can take several years before the machine is presented to the public.

The designer is now more heavily involved in the process and develops the first three-dimensional drawings. "Of course, we are constantly consulting the designer. A lot more detail is taken into consideration during the 3D draft phase, as checks to

determine whether the design will be able to be implemented with the actual dimensions of the machine must be completed," explains Berit Marzinick. At the same time, there are discussions with the Production and Purchasing departments, as well as the suppliers to determine whether the drafts can be implemented practically within a defined budget. Glass fibre reinforced plastic parts, for example, are produced by partners and not by KRONE. If all of the lights are green, the prototypes are built based on the intended design.

### ... and the final design

During the prototype phase, the machines are sent to various customers. These customers test what the design is like in practice. "If they really do not like the appearance, then it will be reconsidered. However, generally, we are in touch with our customers' preferences. This phase is therefore more about testing the operation of the machine. If the user, for example, is covered in dust when opening a flap, then this problem is, of course, resolved before we start production of the machine," explains Frederika Hölscher.

First and foremost, the design must support the function of the machine. "However, if we are able to further increase user benefits with the design then all the better. A very good example of this is the door-in-door principle on the BiG Pack, which makes it significantly easier for the user to replace spools of twine," says Berit Marzinick convincingly, going on to explain: "We know how important the design of products has now become for our customers and their employees. If the appearance and functions do not appeal to them, then this can absolutely influence their purchasing decision."



### ►►► KRONE rear lamp

Have you ever noticed that KRONE vehicles have special LED rear lamps integrated in the KRONE design? During the presentation of the new BiG Pack series, this was introduced for the first time for KRONE agricultural products. Nowadays, you can find it on nearly all green and blue KRONE vehicles. A real eye-catcher!



## EasyCut B 880 CV/CR (Collect) and B 1050 CV (Collect)

# All done in one operation

With the EasyCut B 880 CV/CR (Collect) and B 1050 CV (Collect), Krone introduces new butterfly combinations. The new mowers feature standard conditioners and optional swathing belts. EasyCut B 880 CV/CR (Collect) has arms that adjust mechanically to one of two positions and working widths of 8.52m or 8.72m whereas the arms of EasyCut B 1050 CV (Collect) telescope hydraulically and as such adjust infinitely variably to any working width between 9.3 and 10.45 metres.

Both models have hydraulic swathing belts which merge the conditioned grass into a single and uniform swath during the mowing pass. The swathing width is selected from the tractor cab and to the needs of the following harvesters. Both models are also available with optional accelerating swathing augers for even more precise swathing results. These are particularly useful in sloping fields. The swathing belts can be selected/de-selected independently. Swathing is only one mode of operation, further modes

include the clearance of field edges and independent swathing. Independent swathing on the Collect models means the crop is presented in such a way that the Krone four-rotor rake can rake it up into one swath.



## RX and ZX

# Optimised cutting system

Krone presents new technical and visual updates for the RX and ZX dual-purpose forage wagons. The high-capacity forage wagon ZX has a cutting system that produces very small cuts and offers a load volume of 43m<sup>3</sup> to 56m<sup>3</sup>. The load volume of the RX is 33m<sup>3</sup> to 40m<sup>3</sup>. The precision cuts are delivered by the new OptiGrass cutting system which is available in two versions – the OptiGrass 37 with 40 blades for up to 37mm nominal chopping lengths and the OptiGrass 28 with 54 blades for up to 28mm nominal chopping lengths, the ideal choice for wet conditions.

OptiGrass stands out for scissor-like and precision chops and a uniform cut. Its hydraulic drop function allows operators to lower the unit hydraulically to remove potential blockages and return it into working position after the blockage is removed. The blade cassette also pulls out to the left side for easy replacement of the blades which benefit from individual impact protection. The blades are swapped without the need of tools by operating a central control on the cassette. We also recommend the optional Krone SpeedSharp blade sharpener. This has grinding discs that sharpen all 40 or 54 blades on site, within five minutes and in

two or three grinding cycles. In each cycle, the discs are applied at a perfect angle and a consistent contact pressure.



HEPP LANDTECHNIK, ALLESHAUSEN, GERMANY

# Partnership on an equal footing



The Hepp family  
(from left to right):  
Tatjana, Susanne  
and Wolfgang.

The Upper Swabia region in Germany is an agriculturally diverse region with both cattle and pig farming as well as a considerable number of biogas farmers. Wolfgang Hepp's farming and engineering business is right in the centre of it all. The XtraBlatt editorial team pays him a visit.

**W**e arrive in the village of Alleshausen on a late Friday afternoon, at a time when the working day is supposed to come to close. The theory is that the interview can be conducted in a more relaxed atmosphere at this time of day. But far from it – Wolfgang Hepp and his daughter Tatjana still have a lot to do. The maize silage harvest is nearing completion, the last grassland cut is in full swing, and CCM (corn cob mix) is already being made. It's not just a busy time in the workshop but also at the office where contract machines are being managed and repairs to one of their own trucks is being organised. After all, Hepp is not just an agricultural engineering company but operates also four mobile grinder mixers, sells animal feed and, as the latest project, operates two suction excavators. The company started out as an agricultural contractor, and that side of the business continues to thrive today.

## Versatile

"The company was founded by my parents in 1962," says Wolfgang Hepp. "Agricultural machinery was only added relatively recently in 2003. Our services include combine harvesting, maize sowing and lime spreading. One of the mainstays of our business is the baling of hay, grass and straw, using four Krone BiG Packs. We purchased our first grinder mixer in 1984 to ensure we had enough work in winter. Our fleet now includes four trucks with either three or four axles and a mixing capacity of 6-12 tonnes. Our suction excavators came in 2020. They are used whenever traditional excavators reach their limits. A suction excavator basically works like an oversized vacuum cleaner. It is capable of extracting solid or liquid material." With this technology, the Hepp company has identified and plugged an interesting gap in the regional market.



Wolfgang Hepp regards demonstrators as a valuable adjunct to the fleet.

"I'm often asked about the practicalities of selling and repairing agricultural machinery while running our own contracting business at the same time," continues Wolfgang Hepp. "The assumption here is that our customers will perceive us as a competitor. The reality is very different, as is shown by the large number of fellow contractors on our customer list, who purchase machines from us, have them serviced by us or come to us for spare parts. A big plus for us is that our mechanics have a lot of practical experience in agriculture. This makes itself especially apparent when complex products such as big balers need to be brought into service. And this is precisely where we are a market leader in our region. We look after around 70 balers. Some of our customers operate as many as five or six of them. And because many these contractors run their own workshops, the parts business is particularly important. I also provide a lot of advice on the phone to customers who find themselves at a loss. 'Live and let live' is my motto when working with contractors. I see them as colleagues rather than competitors. This is also reflected in the pricing and the passing on of discounts."

Wolfgang Hepp,  
specialist dealer and  
contractor



The agricultural machinery dealership operates two mobile service vehicles.



In Wolfgang Hepp's experience, the winter check generally ensures that the machines run smoothly during the season.



Partnership  
on an equal  
footing:  
Hepp &  
Krone!

Large square balers  
are mainstay products  
at Hepp Landtechnik.



But this agricultural machinery vendor also does a good trade in mowers, tedders, rakes and silage trailers. Wolfgang Hepp attaches great importance to having a well-stocked demonstrator fleet. This enables him to help out a farmer or contractor when one of their machines breaks down. As a rule, there are usually two demonstration balers and two TX forage wagons in the fleet, as well as forage harvesting machines.

### Core competences

"In our region, there are still one or two very viable farms in every village," says Wolfgang Hepp. "These are my customers. For large-scale dairy farmers it's about getting the mowing done at the right time. Large butterfly mowers or even a BiG M are in demand here. We are not stopping the large farms from running their own fleets – and I am also speaking as a contractor here. I even have a number of biogas customers who run their own forage harvesters. It is important to me that the existing machines are in good condition. Krone is also very mindful of this and offers conversion kits. This not only enhances reliability, but also increases the resale value enormously. The same applies to the winter check. Machine that receive winter checks usually run smoothly."

The used machinery business is also important for the new machinery sales business. Here, Wolfgang Hepp uses the popular online sales platforms. Less costly machines are also marketed in classified ads on the internet. And even WhatsApp status helps with finding buyers. "What I generally don't do is subsidise a new machine deal by trading in a used machine. A straightforward and fair valuation makes sense for both parties. Often, customers will sell their used machine themselves, and I will help them out by putting a market value on it. Most of the time, the machines stay here in Germany. But I have even sold some to customers as far away as China." The result of this somewhat inflexible approach is visible on the company premises: a graveyard for used machines? No way!

### Strong partnership

"Why did Krone choose a small retailer like me for this edition of XtraBlatt?" was Wolfgang Hepp's first question as we began our interview. His own guess: "The partnership works well for both sides. I feel that I am in very good hands with the folks in Emsland. Communication works especially well. Our contacts are experts and have a good understanding of farming. No question goes unanswered. So far, we have solved every problem together. One small point of criticism was that many of the training courses take place in Spelle, which means a lot of travelling time for my staff. But things have recently improved in this regard, because much of the training now takes place online or here in southern Germany."

Wolfgang Hepp is enthusiastic about TIC – the "Technology Information Centre". The system allows him to access a machine directly if the customer has authorised it. He can also obtain further advice on corrective action by entering the error code. "Krone is always quick with something like this," says Wolfgang Hepp. "The service is really good. With other manufacturers, you send an e-mail and then wait for a reply for two months. Krone responds speedily and operates direct channels of communication. Even as a relatively small retailer, I feel I'm in good hands. It's not size that counts here, but quality. And even more important – the human factor."



## SmartBale app

# Collecting bale data



The Krone SmartBale app allows users to use their smartphones to retrieve information on baled crop. The SmartBale app displays a bale map which marks the current location of the user

and the positions of all round and square bales in the field site which are linked to the specific mykrone.green account and in addition reads out automatically all details on the bale nearest to the user. The app also allows users to define a time frame during which the bales can be collected. It also helps drivers or dispatchers to identify fields more easily and faster and manage the harvest chain efficiently. With this app, bales will no longer be overlooked in awkward fields or at night.

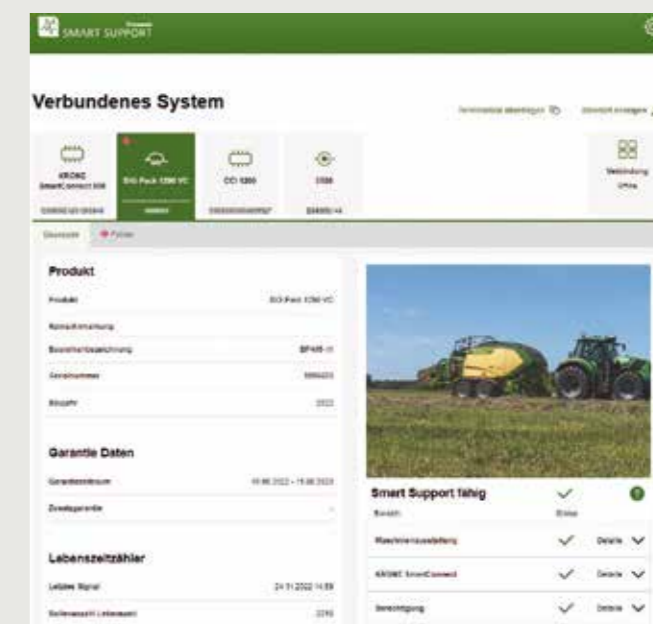
Depending on the data that is supplied by the baler, app users can also retrieve information on moisture levels, bale weights and dimensions and whether the material was cut or not. Wet bales are colour coded so they can be collected and stored separately. The BaleTag feature tags the bale permanently so this data continues to be available even after the bale has been removed from the field where it is still linked to the app. The moment it is removed from its position, the tagger is necessary so the information on weight and moisture as well as harvest conditions, age and provenance continue to be available.

## Smart Support

# Efficient service

The introduction of telemetric technology on Krone machines opens up new possibilities for owners and dealers. Machine owners benefit from the system in that they can retrieve valuable agronomic data from it and use it to grant their dealers permission for a comprehensive service. With Krone Smart Support, dealers can access a machine remotely and view service-related data – owner permission granted. In this context, it is important to stress that the owner is the sole sovereign of the data and only they can grant permission to share data with or withdraw data from service partners. Dealers, in turn, will use the system for marketing their demonstrator machines and illustrating the advantages of a machine to the customer.

The Smart Support system aims at enabling dealers to offer a holistic, efficient and future-oriented service. Therefore Krone grants access to valuable data such as active error codes, the machine's live position and age. This information puts the dealer in the position to respond rapidly and prepare the machine for the next deployment in the best possible way. The overall aim is to minimise downtimes and make optimum use of their own resources.



# Green protein =

Huge quantities in a short amount of time – these are the requirements that the Fromwald family expect from their technology when harvesting forage. XtraBlatt visited Burgenland/Austria.

**KRONE is an important partner for Fromwald GmbH based in Leithaprodersdorf in the Austrian Burgenland region.**

**A**griculture or agricultural trade? At Formwald this is not quite clear. As you approach the site, the first thing you notice are the large poultry sheds. At the very back of the premises there is a large storage building and drying plant. "Our family used to have a small cattle farm in the middle of town," explains Johann Fromwald. "My father took a gamble and moved. He built his first poultry shed in 1981. And because that worked

so well, he built the next one the following year. We now produce 66,000 turkeys a year over three cycles. We put straw down in our stables. As the straw must be of a very high quality, we purchased the technology ourselves."

The first large square baler was delivered on site in 1997. It laid the foundations for our second, successful source of income that the family built up – the production and trade of hay, lucerne hay



The Fromwald team harvests lucerne for farmers in the region and then dries and sells it as high-quality protein feed.

and straw. This sector has grown so much that two BiG Pack balers and a KRONE ZX tridem loading and forage transport wagon are now being used. A second wagon will be added soon. The range of machinery covers the entire forage harvesting chain and includes a butterfly mower, tine conditioner, rake, three telescopic loaders, various platform trailers and three lorries with trailers.

## BiG Pack as an entry level device

The large square baler was used to meet the requirements of the poultry farm, as well as other business activities. It provided the introduction to the agricultural trade sector. Johann Fromwald did not do much contracting with the machine but sold the straw from the outset. Initially, it was stored with farmers but it quickly became clear that appropriate logistic solutions, such as a lorry, would be required for delivery.

In the hay and straw business sector, most customers either own horses or run dairy farms in the surrounding area. Although the products are also marketed further afield. Johann Fromwald then works with trade partners. "Especially when it comes to horses, it is not just important that deliveries are reliable, but customers often have problems disposing of their manure," explains the business operator. "We can take care of that. The manure stores are usually generously sized so that it can be loaded from there several times a year. Where circumstances permit, we also provide containers that can then be moved by our hook loader lorry. The manure is taken to biogas plants in the region, that are designed for this substrate and a high proportion of dry matter." In addition, the straw is purchased from the field. The two KRONE BiG Packs on their own produce 14,000 to 15,000 bales a year.

Raw material from partners within the agricultural sector is also used for the hay production process. The Fromwald family moves, teds, swaths, presses and transports the bales to its own operations where they are stored until delivery to customers. Three, and in exceptional circumstances four cuts can be completed in the region. 3000 bales are sold each year. Some high-pressure bales are also produced, which are particularly popular with horse owners as they are easy to handle. >>>

There are never enough working hours in the day. This is why we leave the maintenance work to the professionals.

**Johann Fromwald, farmer**



The KRONE ZX loading and forage transport wagon is mainly used to transport lucerne from the field to the drying process.



Out on the field and meadow nothing works without a loading and forage transport wagon.

Johann Fromwald, farmer

### Lucerne protein feed

"One day, I noticed that one of my customers was using lucerne hay as fodder, which usually came from Italy," states Johann Fromwald. "However, lucerne is also grown here. Actually to an increasing extent because it is an essential part of the crop rotation process on organic farms. However, in our region it was usually used in biogas systems or even ploughed in. This is where I spotted an opportunity and started looking for a drying plant. Barrel systems are very expensive, which is why I opted for a circulation system. In 2020 that was the first drying plant for organic lucerne in the whole of Austria," states Johann Fromwald, continuing to explain:

"Initially we always mow around 30 ha of lucerne a day. We then use a loading and forage transport wagon to transport it back to site. We then use the telescopic loader to push it into the system. The drying process runs at a temperature of 90°C to

130°C in two shifts. Fresh from the field, lucerne as a max. water content of 30-55% and when it leaves the system this is down to 6%. Even if it means our costs are a little higher, we are more likely to dry it for a little longer to ensure the customer is happy. The last step is to then use a baler which compacts the lucerne into bales. Wire is used for tying because of the very high pressure."

Speaking of costs, the plant is operated with gas, which at the time of planning was considerably cheaper. Nowadays, prices have doubled compared to what we calculated back then. Wood chip would be an even more expensive alternative because of the high costs for the cooling and heating system. If energy costs remain this high, we have the option of connecting the drying plant to a district heating network. The drying process runs from May to October, the drying capacity is 2.5 t/h to 4 t/h. The bale size is 220x110x75 cm, and weighs between 650 kg to 770 kg.

### Logistics must be right

Lucerne can be quite sensitive to harvest. It should be mowed just before it flowers. The swathing process must be completed particularly carefully, otherwise you are only left with the stems. It can be cut up to four times a year. This year, we produced 3500 t of lucerne hay that completely sold out. The cultivation of lucerne hay has now become a business model for farmers. While, in the past, they could not really earn anything, they can now earn around € 500 per hectare. The protein content is around 17% to 21%. Despite this, lucerne hay is not a concentrated feed as it still contains a lot of crude fibre. In addition to feeding cattle and horses, it is also used to feed red deer through the winter.

The logistic solutions must be right to guarantee the harvesting chain. Temporary staff support operations throughout the season, especially when it comes to harvesting straw. Tractors with platform trailers, supported by lorries, are used to

Swathing is completed beforehand to increase the efficiency of the baler. The sale of straw and hay bales is an important part of the business for the Fromwald family.



It is not just Johann Fromwald, who loves farming but also his sons Sebastian, Tobias and Fabian (from the right) and their dog Giacomo.

load the bales. The tractors position their trailers at strategically correct positions on the field and use the front loader to position stacks of three bales which are then loaded on to the trailer. If there is not enough room to transport the bales, the stacks are positioned together. This protects them even if it does start to rain. As the baling process is not started before 10 a.m., the time before this is used to transport the remaining bales from the previous day. They are unloaded directly into the 3500 m2 large hall using a 9 m telescopic loader.

"We are very lucky to have such a great team," states Johann Fromwald. "It really is very important that employees think about the process, as that is the only way it works. However, we also make sure that the temporary staff are happy working for us. They can always access something to drink, get time for a snack out on the tractor during the day, and we serve a hot meal in the evening, as well as enjoying a beer together when we all finish work."

### Reliable service

Especially the work with lucerne places a lot of pressure on the technology and causes a lot of wear. The mower can process 500 ha to 600 ha of lucerne plus 400 ha of grass. All of the other machines used in the harvesting chain are put under the same amount of strain. Ensuring the machines are well serviced is particularly important. "I was impressed by KRONE when we purchased our very first baler," reports the Operations Manager. "During peak season, one of our machines was severely damaged on a Friday evening. The spare part arrived at 6 a.m. on Saturday morning. The machine was back up and running the same day. Our service and repair partner is Steinkellner Landtechnik based in Obdach, Austria. They are quite far away from us but have specialists who can help quickly. Even during the winter they are frequently on site to maintain the machines in our own workshop. We are a purely family-run business. My wife, Petra works in the office, I look after the agricultural and agricultural trade sectors



Both of the KRONE balers are key machines used during the hay and straw harvesting season.

along with our two older sons, Sebastian and Tobias, who both joined us after studying agriculture and agricultural machinery mechanics, respectively. There are never enough working hours in the day. This is why we leave the maintenance work to the professionals."

"I do not rely on government subsidies when planning the strategic direction of my business, I plan everything without them," explains Johann Fromwald. "This is a safer way of going about things. The price for lucerne hay is determined by the price of soya. I set the prices for hay and straw myself based on market conditions. I do not offer any agricultural contracting work. My machines are operated to full capacity at our site, so a contracting business would not be viable. Although everything is running smoothly, we are always looking for opportunities to implement optimisations. I have considered purchasing an overloader for a loading and forage transport wagon that I have already ordered. When transporting by road, the ratio of total costs relative to the loading capacity is simply not beneficial compared to using a lorry. However, out on the field and meadow nothing works without a loading and forage transport wagon."



I was impressed by KRONE when we purchased our very first baler.

Johann Fromwald, farmer

# It was great!

Following a compulsory break of four years, there was a great amount of anticipation about the event – which was far exceeded by the actual trade fair: There was a huge amount of interest in KRONE technology, in-depth discussions and despite challenging conditions for the agricultural sector there was still a noticeable willingness to invest and a positive outlook for 2024. We would like to thank all of the visitors for coming.





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