Inta-Ag Mag

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MOTHERS DAY AT INTA-AG IS BACK!

Page 5

TRACTORS FROM THE PAST DESIGNED FOR THE FUTURE

Page 10

Biostimulant interest hots up

Biostimulants are set to become a hot topic in all UK crop production, with potatoes among those with the most potential to gain.

POTATO REVIEW UK
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WEATHER trends show a clear shift to higher temperatures, including prolonged periods of excessive peaks. And it's crops with shorter growing seasons that can least a˜ord any interruption in peak photosynthetic activity as a result of stress, warns Dave King, Head of Technical at Syngenta.

"Heat typfies the increasing stress potato crops are having to cope with. But there are a whole range of other abiotic influences adding increasing pressure, including drought, nutrition, solar radiation and air quality. "That's where we have seen biostimulants have a valuable role to play in mitigating the effects of stress," he said. "The greater the apparent influence of stress in limiting the crop's potential, the higher the yield response recorded."

Having completed yield trials of a UK study of biostimulant use in potatoes, Dave saidd initial analysis showed a correlation between the high temperatures experienced earlier in the season, and potential for yield responses where crops had been affected.

Using heat as an example of the increasing influence of abiotic stress on crop production, he highlights the latest Met Office State of the Climate report shows the UK is experiencing higher maximum temperatures and longer warm spells.

All of the top 10 warmest years since records began in 1884, have occurred since 2002.

Furthermore, hot summers are expected to become more common. Defined hot spells have increased from an average six days in length during records from 1961-1990, to more than 18 days per year on average during the most recent decade.

The chance of experiencing summer temperatures as hot as any previous record years is now set at an unprecedented 12-25%.

Research has shown the optimum root growth in potatoes occurs at soil temperatures of 15 to 20°C, with a fall off when temperatures exceed 20°C. The relatively shallow rooting of potatoes in the top 60cm of soil profile, compared to cereals rooting to at least twice that depth, makes the crop more susceptible to temperature changes.

Furthermore, conditions for both haulm and stolon growth peak at around 25°C. Warmer soils have also been shown to limit tuber initiation and the numbers of tubers formed. ˝e UK's highest temperature of 38.7°C, recorded in the eastern counties in 2019, exemplifies future challenges for potato production.

BIOTIC TARGETS AND ABIOTIC ELEMENTS

Speaking at the AHDB agronomists' conference, independent biostimulant expert, Rob Cannings of Agri-Future Consultants, outlined where biostimulants sit in the hierarchy of products available to agronomists.

Whilst biostimulants come under the broad heading of biological products, there is a very clear differentiation between those that have an effect on biotic targets, i.e. pests or diseases, and those that target abiotic elements, he explained.

Biostimulants firmly fall under the category where activity is limited to abiotic stress management, he added. As soon as biotic targets are directly influenced, products come under the biopesticide heading with an entirely different set of rules and regulations.

Furthermore, the defining factor is its action, so simply calling a biostimulant by another name doesn't enable claims to be made for biotic targets, or exclude it from regulations where required. "As an industry we need to be consistent about the way that we categorise these products, the way that we use them and the way we label products," he warned.

Rob calculated typically 60% of current crop yields can be attributed to fertiliser inputs, with 40% from crop protection products to keep the crop alive. However, since most crops are still performing way below their genetic potential, the agronomy challenge is how to make better use of those inputs to drive yields nearer to the optimum.

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>
> **ROB CANNINGS, BIOSTIMULANT EXPERT, AGRI-FUTURE CONSULTANTS**

"Future technologies and precision agriculture will all help. But the one area never really looked at is plant health enhancement. How can we better exploit the genetic potential of the plant, to increase yields and to get a better return on investment?" he challenged.

"When you look at biostimulants, it's how we can make fertiliser use more efficient, how we can get more out of crop protection by making the plant healthier. Plant health enhancement has the potential for significant returns for the grower."

He highlighted that biopesticides simply offer a substitution product for existing crop protection products, albeit with possible gains for environmental and consumer interests. Biostimulants, however, have far bigger potential to make a difference and the real growth area to investigate, Rob said.

"Biostimulants need to be considered an integral part of the growing cycle and total inputs," he said. "Maximum effect is obtained by understanding their mode of action, deciding on the desired benefit, and applying at the correct timing."
He cited in potatoes, depending on the timing of application, biostimulants can be seen to have had three distinct effects. Early applications can increase the number of tubers. Application mid-season can reduce the number of tubers misshapen owing to stress, whilst pre-harvest treatment can prevent harvest damage and reduce shrinkage in store.

FIELD TRIALS OBSERVATIONS

David King has also seen dierences in responses to biostimulant use in eld trials, although acknowledges that sheer scale and complexity of the company's latest research makes dening specic stress factor effects harder to pinpoint.

And for crops, or particularly varieties, evolved and selected to perform in relatively cool and lower light UK conditions, they can be ill-prepared for changing climatic conditions. He believes that biostimulants could be crucial in helping those varieties to better cope with challenges.

In the Syngenta trials, it was crops that had been most impacted by the effects of stress, where untreated yields have been most severely limited, that showed the greatest response to biostimulant use.

That makes their use imperative as a way for more efficient use of available input resources, Dave said. "Fertiliser use, for example, is under ever greater scrutiny for environmental and economic impacts, along with carbon footprinting and soil health. Where biostimulants can help develop root structures and plant physiological effects to get nutrients into the plant and better utilised it can improve yields from reduced inputs, and cut risk of environmental loss."

Furthermore, with legislative pressure restricting the crop protection arsenal for agronomists, along with societal desire for reduced pesticide use, biostimulants offer the potential to achieve the best possible results of what is available, as well as opening opportunities new product development.

"Biostimulants and crop protection products are entirely complementary. We know that where plants are under stress they are more susceptible to infection by disease pathogens and the effects are more severe. Alleviating that barrier to plants' natural health increases the opportunity for crop protection to work most effectively," said Dave.

In potatoes, for example, the incidence of Alternaria is closely associated with a whole range of stress factors, including nutrient, heat and moisture, and with a clear link to varietal susceptibility.

Timing of infection also has a significant implication for final yield effects. Biostimulants would offer the opportunity to alleviate some stress factors that could reduce risks of infection, which could prove especially valuable where crop protection options to manage Alternaria are set to be further limited by legislative withdrawal, he said.

INVESTMENT IN COMPLEMENTARY OPTIONS

SYNGENTA has publicly stated that as a company its future lies in reduced pesticide use per crop, but ensuring every application is made more effectively, to deliver better results from fewer inputs. Biostimulants are a key element for future sustainable agriculture and food production, it suggested.

Earlier this year the company bought Valagro, a global market-leader in biostimulants and speciality nutrients in the biologicals market that is expected to double in size in the next five years.

The Group's chief executive, Erik Fyrwald, said the acquisition ties in with Syngenta's strategy to provide growers with additional complementary choices of products and technologies to effectively and sustainably care for crops by managing resistance, enhancing soil health, reducing residues in crops, and addressing consumer demands.

"The investment also forms part of our $2 billion commitment to help farmers address the effects of climate change and improve agricultural sustainability," he said.

As an agronomy tool, David King believes research needs to focus on results of using both biostimulants and crop protection together. "The more we understand about the science behind the biostimulants, the better growers and agronomists can make use of the benefits in different situations. ◆

Beware of Aphids and Whitefly!

This season we have seen a large increase of whitefly numbers in many vegetable crops including cucurbits and in the latter part of the season flights of aphid. Both pests have been controlled using Transform - 2 block sprays 7, days apart.

Another product new to Inta-Ag is the adjuvant Coda K which mixed with insecticides has been very effective on whitefly and aphids. It has no WHP ,but needs good coverage. We have also used it on onions this season, close to harvest and has been effective on onion thrip.

Cover crops – The inside story

Potato Agronomist Eric Anderson looks at sustainable farming practices

POTATO REVIEW UK
WWW.POTATOREVIEW.COM
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COVER cropping should be more than just an afterthought. It is an increasingly important part of the armoury for potato growers with research and experience showing that, if done well, cover crops protect, improve and augment soil between cash crops.

Any time soil is bare, there is potential for cover cropping. But to work properly, it can mean increased costs and additions to a busy workload for the grower, while financial benefits can take several iterations to be realised. This is often frustrating and estimates suggest that few potato rotations currently include cover crops in the UK.

Growing cover crops requires a different mindset as it is function, not yield, that is key. It means thinking about the full rotational and long-term benefits over short-term financial gain.

Those who have made a success of cover crops have found ways to overcome the barriers and effectively integrate them into their cropping systems. This 'whole system' approach puts priority on the success of cover crops by focusing on multiple aspects of management.

It is important to define the objectives and purpose of sowing a cover crop. Is it reducing soil erosion or mitigating water pollution and flooding, soil structure, nutrient recycling, disease or pest management, or providing habitat and wildlife benefits? Will you replace a cash crop or force cover crops between harvest and spring sowing?

Create a management plan that creates a flexible approach, start small and repeat, building on previous achievements. The key to success is the proper seed mix for your soil, and facilitating cover crops to grow for as long as possible to reap the greatest benefit.

"Growing cover crops requires a different mindset as it is function, not yield, that is key."

WHY GROW COVER CROPS?

There is an increasing social responsibility for growers to look after their soils, apparent in government policy and the general public agenda, but the technical and financial benefits start on the farm.

It is not a binary choice, there is a win-win for all. Consequently, there may be opportunity to offset growing cover crops costs through agri-environment scheme participation.

Cover crops have a clear role in protecting soils over winter, retaining nutrients and therefore protecting water bodies. There is also evidence that cover crops, particularly when grown for a number of successive years across rotations, can result in improvements in soil physical, chemical and biological properties which benefits yield and quality.

COVER CROP CHOICE CRUCIAL TO SUCCESS

Although there have been advances in understanding in recent years, there is still so much to learn about the best mix, together with establishment and destruction methods.
It is important to match the individual attributes of a cover crop to the intended purpose, taking into account how it might interact with other partners and any potential rotational conflicts.
To get the best results, assess your soil conditions on-farm before you start.
The soils that see the greatest benefits from cover crops are those that are light to medium-textured. Heavier soils are generally less suitable as they can be more difficult to establish and destroy the cover crop.

Choose your cover crop according to what you want it to do. For example, soils with the tendency to compact can benefit from an oil radish cover crop. It establishes and grows very quickly, developing a deep tap root and laterals that extend out and can help to break up deeper compaction down the soil profile, helping to improve soil structure as well as scavenging mineral N.

Brassica cover crops are the most effective at taking up nitrogen and reducing nitrate leaching, but cereals and phacelia are also effective if drilled early.

'Bio-drilling' is a term used to describe the creation of 'biopores' by deeply penetrating plant roots that allows the subsequent use of these pores by the roots of succeeding crops by offering low resistance to growth.

ADDING VALUE TO LAND

An estimated 80% of potatoes are grown on rented ground. While land agents generally appraise land as a commodity on a short-term basis, few until now have insight into sustainable production systems without granular nematicides or future earning capacity of the land if infested with potato cyst nematodes.

COVER CROP PLANTING DATE CRUCIAL TO SUCCESS

Timing is of the essence because of the need to establish them while soil conditions are still suitable.

Part of the problem is that most have a small seed so an autumn-planted cover crop should be sown earlier rather than later - before mid-August. Remember by growing a larger amount of biomass, you are increasing your own homegrown chemistry toolkit.

After that date you can still grow oil radish or winter rye, as they are frost hardy and can continue to grow over the winter period, but it is too late to establish vetches.

HOW TO MAXIMISE YOUR COVER CROP PLANNING

With clever management, cover cropping works at a number of levels. Planting the right species and variety can reduce the spread of disease, suppress free living nematodes and create more resilient soil architecture. Utilising "flying" flocks of sheep to graze off cover crops can further increase organic matter returned to the soil.

"One of the reasons to grow cover crops – sometimes known as green manures – is to help build soil organic matter."

IMPROVING PEST CONTROL, NATURALLY

More diverse agricultural systems tend to support higher biodiversity. This results in better resource provision for beneficial organisms which carry out ecosystem services, including natural enemies which predate on and suppress insect pest populations. More diverse agricultural systems can be achieved by increasing vegetation diversity and heterogeneity at field, farm, and landscape scales.

It's long been recognised that aphids are preferentially attracted to light reflected from soil in blank beds and the contrasting neighbouring plants. Introducing ground cover into these situations can prevent landing strips for aphids as well as increase natural predator populations. As part of integrated pest management (IPM), it can reduce aphid-borne virus mid to late season.

An example of this is drilling flower mixes in these blank beds, a practical mitigation technique for early generation - FG2 and FG3 - seed growers, with a disproportionately higher number of separation zones between the numerous seed stocks. This creates corridors throughout the crop, increasing biodiversity in a move away from a monoculture system with its high reliance on chemical controls.

Cornflower, common vetch and yarrow are highly effective in attracting natural enemies of aphids. These are low growing plants that are the same height as potato crops.

BIOFUMIGATING NEMATODES

In recent years, biofumigation has emerged as an effective non-chemical alternative to manage nematode pests including potato cyst nematodes (PCN). Biofumigation is the suppression of soil-borne pests, pathogens and weeds by a glucosinolate-myrosinase substrate enzyme defence mechanism present in brassica crops.

In the UK, biofumigation typically involves growing brassica green manure crops. The most common biofumigant species are Indian mustard (Brassica juncea), rocket (Eruca sativa) or the partial biofumigant oil radish (Raphanus sativus). All need to be treated as crops and require careful management. If other brassicas (particularly oilseed rape or vegetable brassica) are grown in the same rotation, growers should avoid those that may result in an increase in club root.

The relative performance of biofumigation can be variable and depends on a range of environmental and agronomic factors. Indian mustard specifically requires maceration, incorporation and soil sealing.

The optimum time to drill a biofumigant crop is between mid-July and mid-August, growing for eight to 14 weeks. The summer–autumn window also enables access to long day lengths and high ultraviolet (UV) radiation, which is important for the production of glucosinolates. Adequate nitrogen and sulphur nutrition is important for maximising biomass, with high concentrations of glucosinolate content. Maximum efficacy of PCN reduction for this window is usually between c.40–70%.

The nature of degradation products depends on factors such as pH, substrate, availability of ferrous ions and the activity of certain protein factors. Soil pH is critically important. If the pH is below 5.6, the chemical conversion of glucosinolates will be driven towards nitriles instead of generating the biocidal isothiocyanates.

Autumn-established biofumigants for overwintering have a relatively lower potential. The restriction is due to shortening days with lower UV exposure and limitations on fertiliser applications. If established by early to mid-August, however, oil radish can be grown over winter during which it releases glucosinolates specifically from its roots. Extracellular myrosinase, linked to microorganisms and common fungi like aspergillus occurring naturally in the rhizosphere of brassicas facilitate glucosinolate hydrolysis.

Oil radish can be flailed or grazed off by sheep ahead of potato planting in March/April and do not require incorporation, which provides a long window for low doses of isothiocyanates to interact with PCN, reducing viability. Maximum efficacy for PCN reduction in this window has been found to be lower at between c.10–30%.

A preliminary consideration that needs to be taken into account is the species and variety of biofumigant used. More information is needed, as there is currently no impartial database of the biocidal isothiocyanate or clubroot profile of a plethora of commercial varieties marketed as biofumigants. It is known that preference should be given to those that produce high quantities of glucosinolates such as sinigrin, gluconasturtiin and glucotropaeolin.

Making the wrong choice of cover crop can increase population density of plant parasitic nematodes. Pratylenchus nematodes in particular can build rapidly when green manures are applied, unless one is used with proven biofumigant properties. A well-documented nematode-fungus disease complex is the interaction between Pratylenchus spp. and Verticillium Wilt (Verticillium dahlia) resulting in Potato Early Dying that causes significant reduction in tuber size and yield.

SOIL STRUCTURE

For many growers, one of the reasons to grow cover crops – sometimes known as green manures - is to help build soil organic matter. In healthy soils, relatively low nitrogen levels limit microbes' ability to utilise carbon compounds, so they excrete them as polymers which act as a kind of 'glue' - creating a porous, interconnected structure in the soil. Over time this increases the volume and connectivity of pore structures, improving the supply of oxygen to micro-organisms, connecting water and nutrient pools to plant roots.

A highly cultivated soil is likely to have reduce aggregate structure, which means the soils disperse readily and can take many months to recover from any punishment they receive. With regular amendments of soil organic matter there is a more extensive network of pores which allow for greater circulation of air, nutrients and retention of water. Furthermore, the carbon within aggregates is protected from oxidation.

Increased fresh organic matter with green manures can increase soil borne rhizoctonia solani.

This emphasises the importance of thinking through what you are trying to achieve. If you are looking to improve soil structure, additions of amendments such as FYM or cover crops are good, but you have to consider other potential unintended consequences.

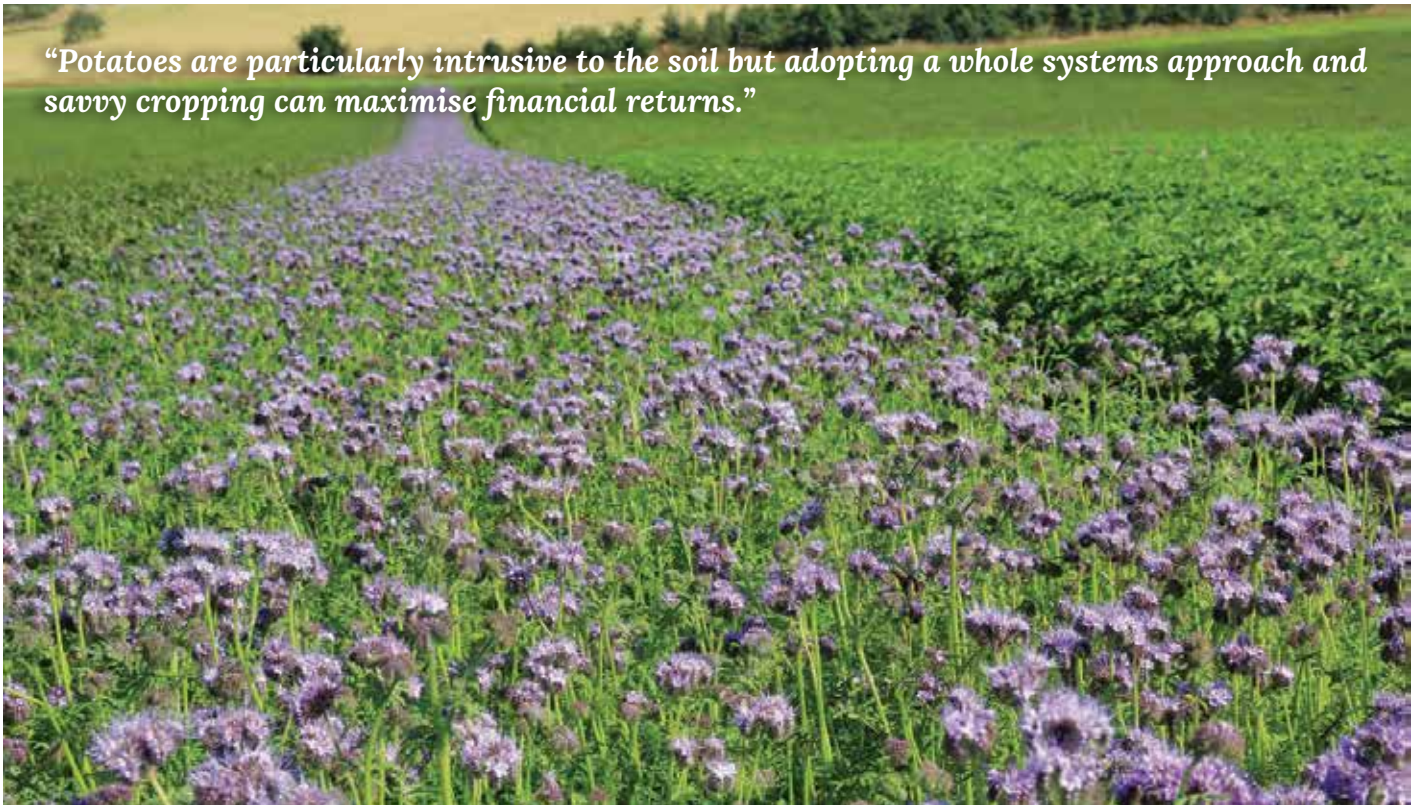
CASH CROPS MAY BENEFIT FROM NUTRIENT CAPTURE

When best practice is used to get the most from cover crops, they act as cost-saving sinks, retaining nitrogen and phosphate in the field which would otherwise be lost via leaching or soil erosion over winter.

In terms of phosphate, the roots of buckwheat exude substances which help to solubilise phosphate that may otherwise be unavailable and have also been found to have a high storage capacity for inorganic phosphate. Therefore, when buckwheat is incorporated into the soil it decays quickly, making phosphate, and other nutrients, more available to the succeeding crop.

CREATING THE FOUNDATIONS FOR HARVESTS TO COME

Cover cropping does demand a different way of thinking, but we are seeing greater uptake among our members alongside a regenerative and sustainable approach to all management practices. Potatoes are particularly intrusive to the soil but adopting a whole systems approach and savvy cropping can maximise financial returns, as well as creating the foundation for harvests to come. ◆



Tractors from the past designed for the future

The HT 340 experimental tractor
© Supplied by Mike Williams

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There have been plenty of attempts to predict future developments in farm tractor design, but most of the ambitious and unorthodox ideas have, so far, failed to emerge.

Several of the design projects were aimed at assessing tractor requirements for future farming generations but, to attract maximum publicity, they often carried exotic exterior styling and some very attractive interior spec additions.

The eye-catching appearance of International Harvester HT-340 tractor stimulated plenty of interest when it was shown in the US in 1961, but there was an additional reason for the streamlined shape.

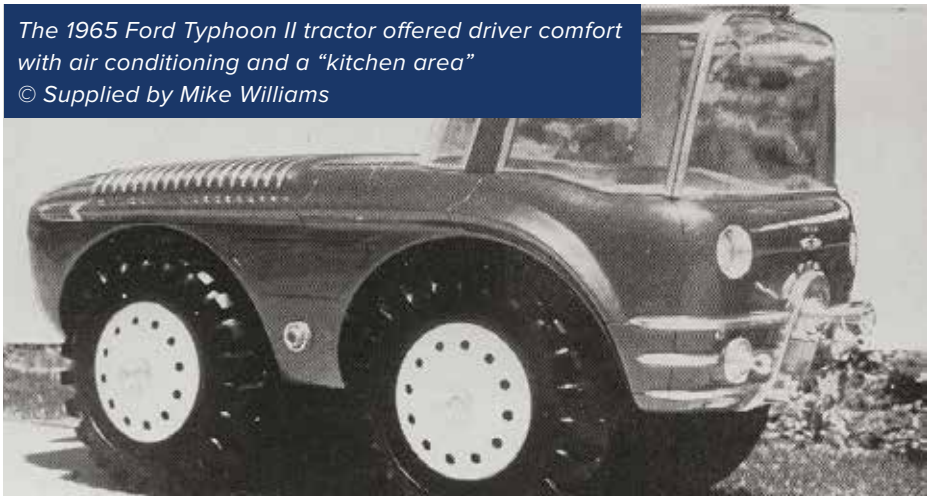
The styling helped to draw attention to the fact that the body panels were made of fibreglass. This offered corrosion resistance and built-in colour to avoid the need for a respray, and was relatively easy to repair after a minor mishap. In spite of its prominence on the HT-340, sheet steel remains the standard material for the main bodywork on tractors, with synthetic products used for parts such as mudguards and engine compartment covers.

An International Harvester (IH) subsidiary company had recently diversified into gas turbine engine production, with one 80hp example designed to power a helicopter. A version of the engine featured in the HT-340, and was one of the reasons the company built the tractor.

This type of power unit was making headlines after the Rover company in Britain had demonstrated the world's first experimental gas-turbine-powered car, perhaps prompting IH to evaluate a similar power unit for tractors.

If so, the results were probably disappointing. Gas turbine efficiency needs constant operating speed and power output in situations such as long-haul aircraft flights, and the engines are less suitable for the varying loads associated with tractor work. Noise is also a problem in vehicles, and it is probably significant that the HT-340 driver in the photograph appears to be wearing ear defenders at a time when these were rarely used on farms.

A more positive development on the HT-340 was the use of a hydrostatic transmission when this type of drive system was almost unknown on farm equipment. This appears to have been a success because, soon afterwards, IH became the first major company to introduce hydrostatic drive on a production tractor.



The 1965 Ford Typhoon II tractor offered driver comfort with air conditioning and a "kitchen area" © Supplied by Mike Williams

KITCHEN AREA FOR THE TYPHOON II

In the early 1960s, when designers at the Ford Motor Company tractor plant in the US were asked for their ideas about future developments, the replies showed a big emphasis on improved driver comfort and convenience.

This result was probably influenced by the fact that driver welfare had become a major issue on farms after 1959, when Sweden became the first country with legislation requiring new tractors to be fitted with safety cabs – the UK followed belatedly in 1970.

Results of the Ford design survey were used to build the Typhoon II tractor, completed in 1965, as a slightly less than half-sized model which became a star attraction at the Smithfield Show in London.

Driver-friendly features on the Typhoon II included a layout placing the engine at the rear and the cab at the front to improve forward visibility and control, and Smithfield Show visitors would have been impressed by the lavish equipment list. This included a swivelling seat that also tilted to keep the driver upright on side slopes, and a "kitchen area" behind the seat featured a cool box, food warmer, coffee maker and a hand-wash unit.

Under-floor heating coils warmed the driver's feet on a cold day, and his hands were free to manage the controls because the steering was operated by foot pedals instead of a wheel or levers. Perhaps the most futuristic feature was built-in equipment to provide the driver with constantly updated local weather forecasting.

The Typhoon II also included a hydraulically operated raise-and-lower feature to vary the ground clearance, and ptos were provided at both sides as well as front and rear. To compensate for the poor rear visibility from the front-mounted cab, a 3D external TV camera linked to a screen allowed the driver to monitor equipment behind the tractor.

REVERSIBLE SEAT FOR KUBOTA TALENT

External TV cameras were also included on the Talent 25 tractor shown by Kubota at the 1970 World Fair in Tokyo, with a screen in the cab giving external views to both sides and the rear.

At that time, Kubota was achieving an international reputation as a specialist manufacturer of compact tractors, and the 25hp Talent hinted at exciting future developments in this sector of the market.

The design included a reversible seat and controls, soon offered on some Kubota production tractors. The cab had no side access, with entry or exit through doors at the back – even the most agile drivers may have found this difficult with a rear-mounted implement attached.

225HP V8 VANTAGE

While leading tractor companies had an obvious incentive to investigate future design ideas, there were other organisations with a similar long-term interest. These included United States Steel (USS) which supplied a wide range of types and grades of steel to large-scale US manufacturers, including tractor companies.

In 1970, USS published details of its Vantage tractor project, designed to "motivate the creation of more advanced agricultural equipment designs".

Vantage was never built, but it was planned in great detail and widely publicised – power was to come from a 225hp V8 diesel engine, which USS correctly predicted would become an increasingly popular tractor size on US farms during the 1980s.

The engine was mid-mounted, with the power delivered through a hydrostatic transmission providing four forward ranges and a reverse. Four-wheel drive came via equal diameter wheels, plus it had front-wheel, rear-wheel, four-wheel and crab steering modes.

The Vantage project also included designs for more than 25 special implements and attachments to work with the tractor. These extended to front-mounted, rear-mounted and wrap-around machines using power available from ptos located at the rear and one side. The latter could be used to power front-mounted equipment.

Triangular attachment points were used instead of the standard three-point linkage, and one design feature that Vantage is said to have pioneered is providing external controls to simplify the coupling of linkage mounted equipment.

Cab entry and exit were through a pair of rear doors on Kubota's Talent 25 tractor © Supplied by Mike Williams

NIAE TRANSPORT TRACTOR

Bedfordshire based Silsoe Research Institute – previously called the National Institute of Agricultural Engineering (NIAE) – closed in 2005 when its government funding ended, but one of the most ambitious projects in its long history was the experimental farm transport vehicle.

This was based on a research programme that started in 1973, with surveys showing that transport had become a major part of the workload for tractors on farms in the UK and Germany, and that a substantial number of farms could benefit from a tractor designed with transport efficiency as the top priority. Construction work on the research vehicle began at the NIAE's vehicle and cultivations division in 1980, with the test programme kicking off in 1983.

The engine chosen for the transport tractor was a 104hp Perkins, which was later uprated to 126hp, and the tractor was based on a chassis with a front-mounted cab leaving a large area for carrying specially designed or adapted demountable load carrying and working bodies using a hook-lift handling system.

The cab was positioned on the right, leaving space on the left for a hydraulically operated front loader or a forage harvester.

Demountable attachments included a rear delivery manure spreader with the wheels and drawbar removed, plus a fertiliser spreader with 3t load capacity.

As the NIAE tractor was designed entirely for research, with no production plans, it was equipped with two different transmissions to allow comparisons to be made.

One was a truck-type mechanical gearbox with a hi-lo transfer box providing 10 forward speeds, but the driver could also choose a hydrostatic transmission. The maximum forward speed was 65kph, and the specification included four-wheel braking, front and rear suspension and a 10t gross weight carrying a 5t payload.

The transport tractor brought plenty of interest at demonstrations and open days, with praise for the ride comfort provided by the suspension and for the convenience of the demount system. However, the NIAE design features have not so far made much commercial impact. After several years in storage, the original vehicle was eventually sold and is believed to be in a vintage tractor collection. ◆

The US Steel Vantage tractor concept was publicised in 1970 as a realistic approach to the farming industry's future needs © Supplied by Mike Williams

The NIAE experimental farm transport vehicle had a raft of demountable attachments © Supplied by Mike Williams

Specially adapted manure spreader demonstrating the hook lift-type load-carrying system on the NIAE transport tractor © Supplied by Mike Williams