Crop production

Giving the plant exactly what it needs

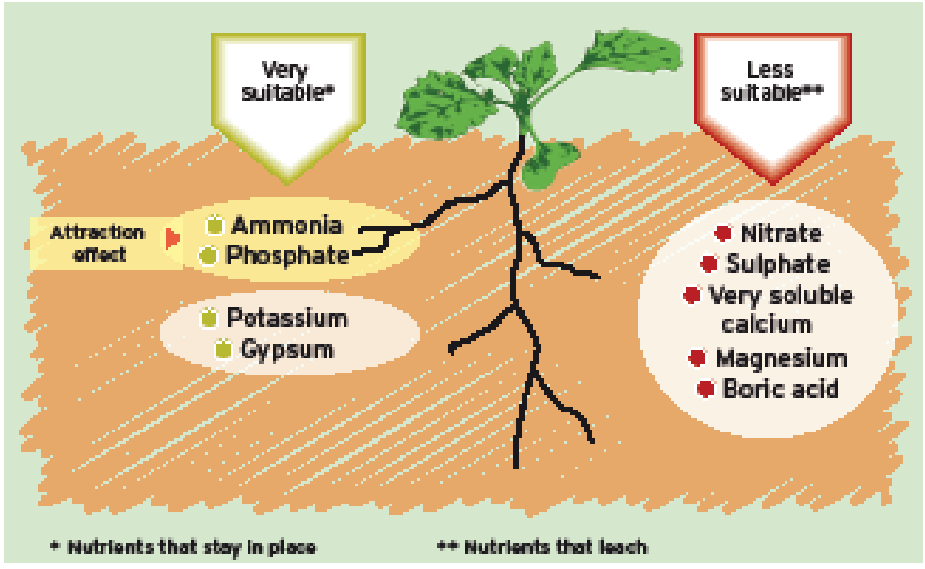
In »Precision Farming« one still mainly thinks of the technology involved. But there are now cropping systems centred more on the plant and its requirements – and utilising precision farming to meet these needs.

Should we broaden the term »precision farming« to cover much more? Already established are applications for site-specific crop production. But more recent developments include techniques to help individual plant establishment while still saving inputs such as fertiliser and diesel, reducing traffic on field surfaces and protecting the soil.
»Even when applying precision farming, we are still working comparatively unspecifically«, says Roland Hörner from the DLG Agriculture and Food Center. »Here, we crop growers can learn from animal production. After all, we don't simply throw some feed into the barn. Instead, we portion it out directly to the individual animal, according to performance.«
Strip-tillage, precision seeding, placed fertiliser and controlled traffic farming (CTF) are the important key words for this type of crop production. Some of it still lies in the future, particularly CTF. But the other techniques are already used in practical farming. Together, they present a »precise« crop growing system aimed at supporting the growth of each individual plant.
Strip-tillage had its beginnings in the USA. This method doesn't cultivate the entire field surface but instead only strips for the subsequent crop rows. »This combines the erosion and evaporation prevention advantages of direct drilling with the more reliable emergence and higher yields of deeper cultivations«, says Dr Wilfried Hermann from Hohenheim University's Ihinger Hof.

Strip drilling improves soil moisture efficiency and reduces labour input. This method has now become established with maize and beet with the farm machinery sector adjusting the system to suit European cultivation conditions. In Germany especially Horsch, Köckerling, Amazone and Kuhn have appropriate implements in development or in action now. Since 2009 pioneering farmers have been trying out the technique with oilseed rape and wheat and the first experiences are very promising. Particularly appreciated: the reduced cultivation input, more precise fertiliser application possibilities, reduction of erosion risk, effective soil moisture management and the optimal root growing area that the system produces. »Especially recommendable In the case of oilseed rape is the combination of strip-till and precision drilling. Here, individual plants are able to establish themselves better and can take advantage of the broader inter-row gaps compared with conventional drilling spacing«, explains Dr Joachim Bischoff from the Saxony Anhalt Institute for Agriculture, Forestry and Horticulture.

The »right« breadth for the strip and inter-row spacing are still being discussed. While some favour so-called »black strips« 15 to 20 cm broad at spacing of 37.5 cm or half a maize row, others still experiment with row spacings of between 50 and 70 cm. When it comes to cultivation depth, this mainly depends on the previous crop, the crop to be established, and its species-specific rooting pattern, as well as soil type and condition. Well cultivated strips are free of straw and loosened uniformly with appropriate recompaction.
This means the technique is not suitable for all sites. A good tilth without seedbed cavities is needed for optimum seed placement and resultant reliable emergence. Problematic are fields with high clay con-

Which nutrients are good for placement?



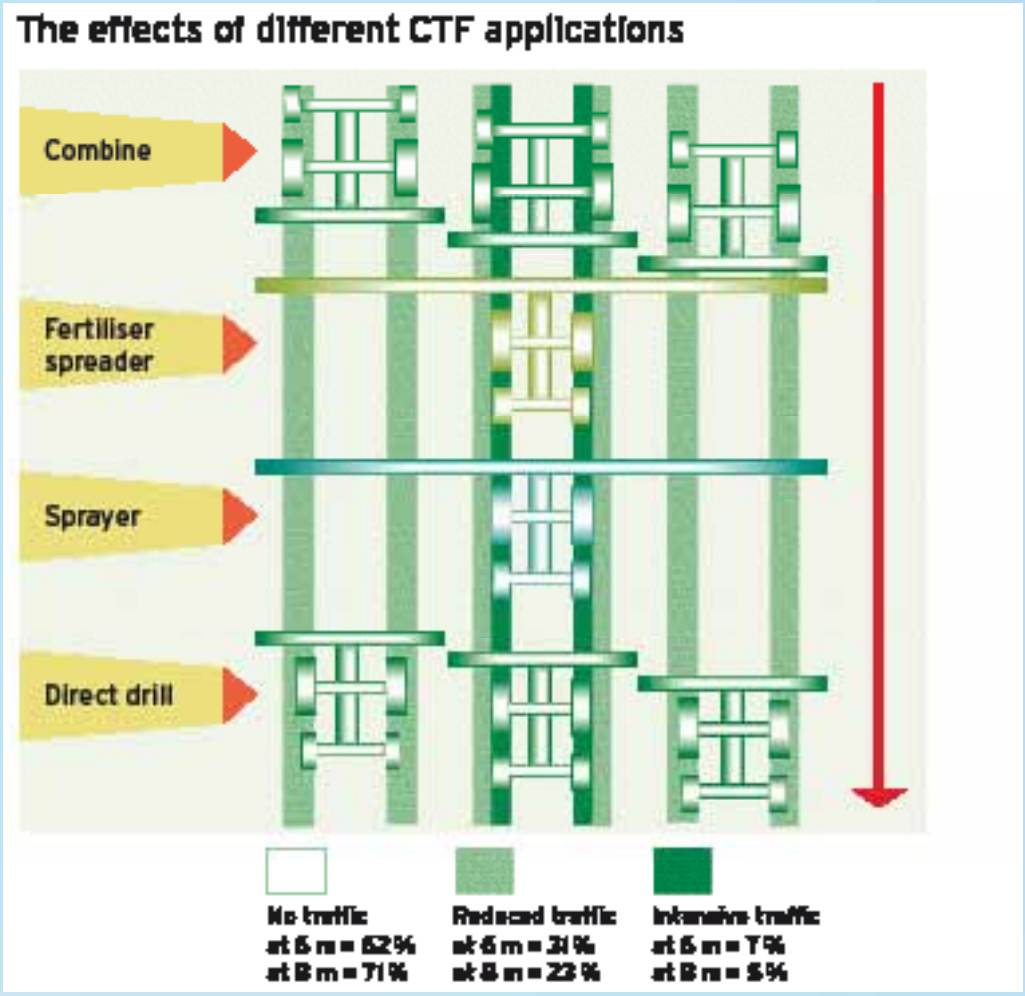
New designs of cultivators increasingly include added equipment for underfoot fertiliser placement.
Neue Grubber haben immer häufiger eine Vorrichtung zur Unterfußdüngung.
Les nouveaux chisels sont de plus en plus prééquipés pour un apport d'engrais en localisé.

tent. Especially suitable, on the other hand, are light soils with natural drainage.

Closely associated with drilling into strip-till is precise placement of fertiliser, a technique that offers an advantage. »After reaching this depot a high concentration of the nutrients can be more easily and rapidly taken up by the plant«, points out Bernhard Bauer from the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben. Placed fertiliser is especially recommended when soil basic requirements are not optimal – above all in the case of cold, wet soil with structural problems or in dry conditions and/or excessively loosened ground. However, before deciding to place fertiliser one has to carefully reflect what should be achieved with the technique. Type and amount of fertiliser, placement depth and time of application all have a decisive influence on root growth.

Fertilisers with »attraction effect« are above all ammonia and phosphate. Placement of these nutrients as depot in soil can be used to influence rooting form. »Important is that the fertiliser band lies at the right depth and that the amount is appropriate. Otherwise, shallow rooting can be encouraged or a depot lying too deep cannot be reached by the roots«, explains Bauer.
But a placed nutrient has to keep position, and not spread throughout the soil profile with time, he warns. This characteristic is brought by all nutrients that can be very well adsorbed in the soil matrix (ammonia, phosphate, potassium), or are not easily dissoluble such as gypsum or calcium borate. In that the target is best-possible availability for the plant, the first-named nutrients are most suitable for placed fertilising. With phosphate, however, water-soluble forms should be used. Potassium hasn't an »attraction effect«. That's why a »combined« depot with ammonia or phosphate is advisable so that the latter can attract roots where they can also assimilate nutrients such as potassium or difficult to dissolve calcium or boron forms.
On the other hand, only in certain cases are nitrate, sulphate, very soluble calcium, magnesium and boron suitable for placed fertiliser because these nutrients do not remain in the fertiliser band.

Strip-tillage offers optimal conditions for underfoot (5 to 10 cm) or deep-placed fertiliser (15 to 25 cm). Hereby the fertiliser is placed directly behind the tines in the seed strip at the desired depth. A great advantage for the crop in otherwise poor growing conditions, this ensures direct positioning of basic fertilisers, as well as nitrogen, right beside the roots. Favoured fertilisers in such cases are ammonium sulphate (SSA) and di-ammonium phosphate (DAP).



Controlled Traffic Farming features the establishment of permanent tramlines. So that as little field surface as possible is driven over, track widths of all vehicles are adjusted to match that of the widest machine (as a rule the combine harvester).
Beim Controlled Traffic Farming werden permanente Fahrspuren angelegt. Um möglichst wenig Fläche zu befahren, passt man die Spurweiten aller Fahrzeuge an die breiteste Maschine an. In der Regel ist das der Mähdrescher.
Le Controlled Traffic Farming permet de repasser en permanence sur les mêmes passages de roues. Pour réduire la surface nécessaire, la trace de tous les matériels est adaptée à celle de la machine la plus large, la moissonneuse-batteuse en principe.

Neesham

For temperate crop growing conditions there are two possibilities of strip drilling. The classic variant features two steps: cultivation of the strip including underfoot fertilising and then drilling, which can be carried out with a second underfoot fertilising. Required for this technique is application of a GPS system with RTK accuracy in order to identify the strip position. Such an approach is especially advantageous for crops that need warmth such as maize. In the cultivated strip the soil has a chance of warming before the actual sowing.
In the second variant strip-till includes cultivation, underfoot fertilising and drilling in a single pass. There's no need for expensive RTK-GPS in this version. But it requires a comparatively heavy implement set-up and supporters of the split system criticise this aspect, as well as the compromise that has to be made between the disparate optimum speeds for cultivation and drilling. This approach also allows preliminary cultivation of the field, although if this preliminary work isn't carried out along the strips it no longer follows the concept of strip-tillage.

This soil protecting crop production system can be further extended through permanent tramlines, the so-called Controlled Traffic Farming (CTF) concept whereby all vehicles stay on the same tracks. This means machinery working widths and their tracks have to be adjusted for compatibility. Between the permanent tracks the soil is not driven over at all so that surface and sub-surface compaction is avoided. Australia was where the breakthrough for this concept occurred in the 1990s when GPS steering systems were introduced. Satellite-guided steering allowed tramlines to be established and accurately found again every year. Farmers report an increased water filtration, looser soil structure, less tendency to erosion, improved crop emergence, more intensive rooting and increased yield stability.

In den vergangenen Jahren haben sich mit Hilfe von Precision Farming-Technologien einige interessante Produktionsverfahren entwickelt, die das Pflanzenwachstum optimal fördern und nachhaltig den Boden, die Wasservorräte und den Geldbeutel des Landwirts schonen. Der letzte Feinschliff fehlt dabei sicher noch. Es gibt jedoch Forschungsprojekte, die sich mit der Weiterentwicklung beschäftigen, und auch die Technik bleibt nicht stehen. Letztendlich braucht es aber immer einige experimentierfreudige Landwirte, die die neuen Systeme praxisreif machen.

Dans un passé récent, les technologies de l'agriculture de précision ont permis de développer des itinéraires techniques intéressants qui favorisent une croissance optimale des plantes, préservent le capital sol, les réserves en eau et en bout de course le portefeuille de l'agriculteur. Le dernier ajustement est sans doute encore à inventer. Il existe des projets pilote qui ont pour objectif d'améliorer encore ces itinéraires. Les matériels également progressent. In fine, il faut aussi toujours quelques agriculteurs courageux, prêts à expérimenter ces nouvelles solutions pour qu'elles puissent être adoptées dans la pratique.

Strip-till drilling reduces soil moisture requirement, buffers extreme weather effects, encourages soil life and saves time and money.
Die Streifensaat reduziert den Wasserbedarf, puffert extreme Witterungsereignisse ab, fördert das Bodenleben und spart Zeit und Kosten.
Le semis en ligne diminue les besoins en eau, réduit l'impact des phénomènes climatiques extrêmes, stimule la vie du sol et économise du temps et des coûts.

Overlapping is also reduced so there's also a possible saving of inputs such as diesel, seed, fertiliser and plant protection sprays. Less compact soil also sinks required draft for implements while the compacted tracks reduce rolling resistance.

»Combining CTF with strip-tillage/drilling means one can even consider laying irrigation pipelines for precise placing of moisture and fertiliser«, reckons Roland Hörner from the DLG. Even when this seems at the moment somewhat futuristic such techniques could become more important in the light of climate change and worldwide increasing demand for food.
CTF systems primarily developed for Australian conditions cannot be simply taken over by us, however. »For minimising the proportion of field area not used for cropping, track widths of around 3 m and narrow tyres are used«, explains Martin Holpp from the Swiss research Institute Agroscope at Reckenholz-Tänikon (ART). Tractor and trailer tracks are widened to those of the harvesting machinery. This causes problems for tractors on the public roads. Where a tractor has an overall width of 3.50 m it can no longer be driven on German public roads, for example. Permitted payload and maximum speed also sinks. This means that the system has first to be matched to European conditions.

A number of pioneers In Britain, Denmark, the Netherlands and Germany are already testing a slightly altered variation of the Australian technique whereby tramlines are further utilised in part. »All working widths for machinery such as combine harvesters, sprayers and fertiliser spreaders are based on a basic distance (e.g. 6 or 8 m) or multiples thereof«, according to Holpp. This approach means there's no universal track width but still allows a completely undriven-on field surface proportion of 62 to 71 %. First experiences In Europe are positive but there are very high investment costs in technology (RTK-GPS-parallel tracking, re-equipping machinery) and further hurdles to CTF acceptance in mid-Europe. For instance there's little sense in introducing the system on short-term rented land where Australian experience indicates that a single passage over the untracked land is sufficient to destroy all the accumulated advantages mentioned above. Also, when a machine breaks down the contractor cannot simply take over the work. And spreading farmyard manure, as well as beet and potato harvesting, doesn't fit the pattern.

Katrin Rutt