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Cultivation of maize – which sowing row distance is needed?

Every square meter counts in maize cultivation in order to help meet the challenges of higher farmland rents and the global requirement to get as much yield out a steadily shrinking total of available land. The results presented here from the examination of different sowing widths with maize come from several years' trials on different locations in Schleswig–Holstein using agricultural machinery from practical farming. It seems possible that yield of maize can be increased by specific sowing techniques involving different row widths and this must be considered when planning sowing strategies and buying appropriate drilling machinery.

Keywords

uniform coverage, seeding rate, row distance, maize, On-Farm-Research

Abstract

Landtechnik 66 (2011), no. 5, pp. 370–372, 3 figures, 4 references

The protection of the soil at water- or wind-endangered locations contributes to any discussion on the correct row distances. New soil formation in Germany amounts to about 2 to 3 t/ha in a year. In erosion endangered areas approximately 8 to 10 t/ha are lost in the same period which equates to overall loss of 5 to 8 t/ha of topsoil. The FAO estimates that about 16 % of the total area (rural and agricultural) within the EU is at risk because of erosion (12 % by water and 4.4 % by wind) [1].

Maize cultivated on poor yielding regions or areas requiring improvement has in recent years encroached into more fertile arable regions to meet the demand for high value silage for milk cows as well as the strongly growing requirement for biogas plant biomass. But the change in demand in raw material markets has led in some regions to a partial decline in maize production areas. The areas left in production need new cultivation strategies to meet the continuing demand.

Crucial questions and solution methods

A crucial question in maize cultivation is the necessary row distance to ensure optimal plant distribution and utilisation of space and at the same time to conform with the cross compliance (CC) guidelines for erosion protection.

According to the CC guidelines, as from the July 1, 2010 the plough cannot be used in spring on erosion endangered areas for row crops (maize, sugar beet and potato) when the seed row distance is greater than 45 cm.

Hitherto, accepted economical arguments had kept the accepted maize row spacing at 75 cm. For energy maize production – where the energy must not strictly be contained in the cob – other row distances such as 55 cm, 50 cm, 37.5 cm or even 25 cm are conceivable in order to achieve better utilisation of space and fertiliser. Seed row distances less than 45 cm have proved practical over many years in water protection areas. Other strategies in maize cultivation worldwide are also being practised. For example, breeders recommend sowing maize under plastic sheets in regions with long moist winters where the soil temperatures in spring remain under 8° C for considerable periods. Sowing under plastic sheets mainly takes place in Canada and Ireland.

Another new strategy in maize cultivation – ridge planting – is mainly being practised in northern Germany with other crops so far, e.g. sugar beet or vegetables such as carrots. Due to the increased soil surface area, especially on light and moist soils, ridge planting leads to a quicker warming in spring. This method has become established mainly in the coastal regions of Lower Saxony and Schleswig-Holstein for beet cultivation. All these strategies have been tested and evaluated since 2007 initially in field trials with conventional machinery at several locations in Schleswig-Holstein. Since 2007 continuous large-area trials of row width, seed density and fertiliser intensity have been carried out on arable land and land improvement locations. These trials are aimed at clarifying crucial cost and cultivation questions.

This article will discuss only row distances of 37.5 and 75 cm (**Figure 1**).

Seed row distance and plant distribution

Several standpoints on the topic of row width for maize are presented in the literature [2, 3, 4]. Some say yield increases with closer seed rows are only possible with more side dressing, others say it is possible with the same amount of fertiliser – but all report higher yields. Demmel et al. (2002) [3] were

Fig. 1

Maize with 75 cm sowing row distance (left), narrow sowing row maize with 37.5 cm distance (right)

able to show in trials over several years an increase in 2.8 % of dry matter and a 5.3 % higher energy yield with narrower seed rows. Peyker et al. (2004) [2] carried out practical trials from 1997 to 2000. They also reported higher yield levels.

The issue of row width principally concerns the best possible uniform coverage for the individual plants as illustrated in **Figure 2**

The better the distribution of individual plants in the field, the more space the plant has, leading to better root formation and utilisation of nutrients. Lower nitrate residues with narrow sowing indicate better utilisation of nutrients. The mathematical optimal crop density of 9 plants per square meter, at which plant distance in the row is the same as distance as that between rows, is achieved with 32.5 cm row distance. Then, each individual plant would have the same space available as its neighbour (**Figure 2**).

But these row distances are barely possible with present single-seed sowing technology since the space between coulters is narrow with depth control and seed hopper size then problematical. Hence, the half row distance of 37.5 cm was chosen for the trials, with the same number of seeds per m² as with the conventional 75 cm. The additional expenses for machinery for sowing, i.e. twice as many single seed aggregates, must then be compensated for by higher yields.

Results

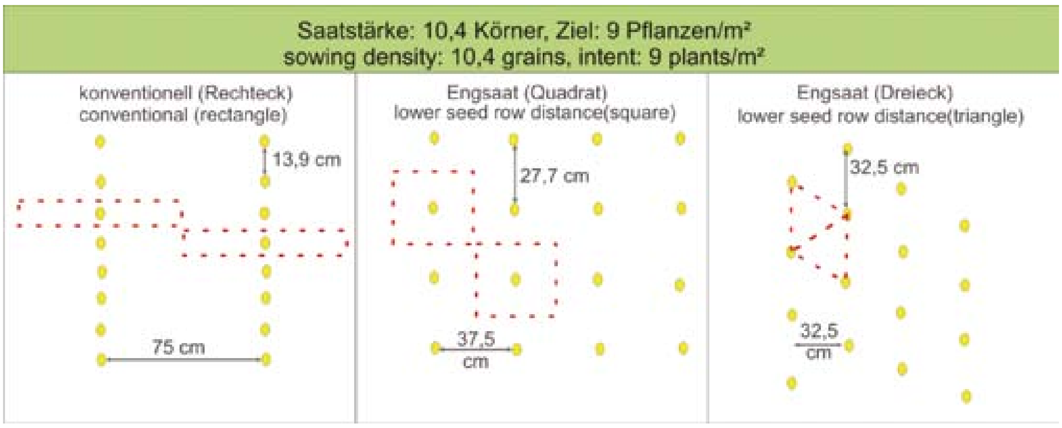
Calculations from contractors' figures indicate costs totalling 45 € per hectare for the conventional row width and 66 € per hectare for the narrower 37.5 cm row width. Our own trials confirm this.

Narrow sown plots see crops closing the rows 2 to 5 weeks earlier, depending on location, so reducing irradiation on soil and resultant evaporation of water from the upper layers. Fewer weeds were also able to develop so their influence on yield was reduced. Results showed that, depending on weed infestation, one herbicide application could be saved or at least adapted to level of infestation. This could save up to 30 to 40 € per hectare plus application costs (7 €/ha).

Another big advantage of narrow row sowing, from a technical production point of view, is the easier establishment of tramlines for application of organic nutrients (liquid manure, biogas fermentation residues) in the growing maize crop. Crop nutrient requirements can this be met promptly and efficacy of the organic fertiliser increased. **Figure 3** shows results from the row trials with multiple repetitions with the same seeding rate and the same fertiliser rate per hectare.

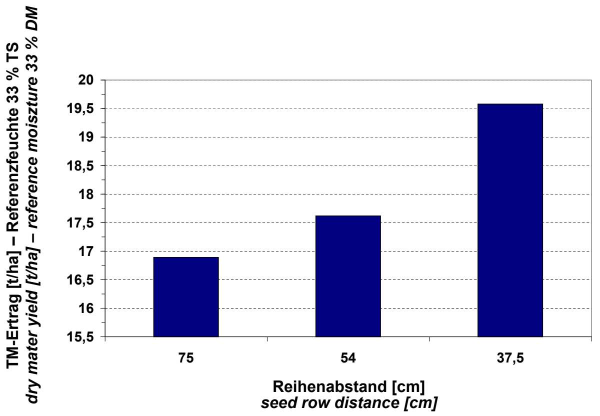
The average of 10 % higher yield achieved for the medium-early varieties used in the trials over the years shows a clear advantage for narrower seed rows (37.5 cm). Assessments made

Fig. 2



Corn distance in seed row with different sowing row distances

Fig. 3



DM-dry matter yield 2009 in different sowing row distances (difference exception 5 % = 0,44 t/ha)

before the harvest indicated a slightly lower cob weight but no reduction in energy content of the whole plant. The later ripening (approx. 1 to 2 weeks) observed in the narrow sown fields eased harvest management for farmers and contractors.

Gas production analyses via the Hohenheim biogas test show a slight advantage for narrow seeding. The average methane yield – measured in norm cubic meter per hectare – amounted to 6 069 m^3 i. N./ha in the conventionally sown rows and 6 093 m^3 i.N./ha in the narrow sown rows. The 10 % increase in yield was not reflected in the methane yield increase. But for biogas producers the dry matter yield is of most importance, the methane yield being influenced by retention time.

Conclusions

The trial results show that maize yield increase is possible through specific choice of sowing technology. The use of maize silage as feed or for energy production raises the demands on production methods. High energy content and high yields are economically necessary with both targets. Especially critical is the multiple usage of silage from a silo, since the differing times up to energy production from the silage dry matter play a role. The quantities of methane obtained, and the energy gained from it, confirm the yield results. The results show that narrow sowing provides advantages through earlier row closure (lessening erosion), better plant distribution (utilisation of nutrients) and higher yield. The additional expenditure is correspondingly justified and covered. This is also confirmed by other sources [2, 3].

Literature

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