Results from Sweden using ridges in maize cultivation

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Introduction

The cultivation of maize (*Zea mays* L.) in Sweden is at many places limited by low temperature for a mature crop. Besides choosing an earlier variety, cultivation measure as growing maize on ridges could be a way to extend the season. The hypothesis is that the ridges are heated up faster than flat soil, especially in clay soil. Positive results on yield response from growing maize on ridges have been reported from trials in Denmark (Henriksen, 2005). However, later trials in Denmark have not been able to show any positive effects of using ridges on yield (Oversigt, 2006). Investigations about using ridges in maize have been used mostly in the tropics. The aim of the project was to test if there were any positive effects on yield and nutrient content of silage maize when using ridges.

Methods

Field trials were conducted at two contrasting sites during two years. The sites were Västerås (59º61N and 15º65E) and Kristianstad (56º10N och 14º30E). The years were 2008 and 2009. The design was a split-split-plot with three replications. The three treatment factors were: two sowing times, early (soil temperature 4-6°C); and normal (soil temperature 6-8°C); two soil tilling methods, ridges (20 cm high) and flat soil; and three varieties (early, mid late and late). Soil temperature was estimated. Sowing time is given in Table 1. All varieties were harvested at the same time. In Västerås, the normal sowing time 2009 was delayed due to dry conditions and harvest was delayed 2008 due to excessive rainfall. Emergence was zero 2008 because of soil surface crust formation in the ridges in the normal seeding time after heavy rains. Varieties were Avenir, Isberi and Eurostar at Västerås and Isberi, Eurostar and Happi at Kristianstad as early, mid and late varieties, respectively. The ridges were made by a ridger immediately before sowing and ridges were about 25 cm high, but shrinked to about 15 cm. Soil was sandy loam at Kristianstad and clay loam at Västerås according to the FAO description. Each plot had four rows about 10 m long with a 75 cm row distance and the inner two rows were harvested. The temperature was recorded every hour with Tiny tag plus 2 data loggers in the early sowing of the middle late variety at 5 cm below soil surface in both flat soil and ridges. The loggers were repeated in two replicates. Temperature sums of daily means were calculated until 1st July for the early sowing time in Table 2 with a threshold of 5°C.

Table 1. Dates for sowing and harvesting including length of growing periods

Trial	Early sowing (ES)	Normal sowing (NS)	Harvest	Growing period of ES, days	Growing period of NS, days
Kristianstad 2008	2008-04-19	2008-04-30	2008-10-13	177	166
Västerås 2008	2008-05-08	2008-05-15	2008-11-04	180	173
Kristianstad 2009	2009-04-20	2009-04-29	2009-10-04	167	158
Västerås 2009	2009-04-30	2009-05-26	2009-10-16	169	143

Table 2. Temperature sum (TS, threshold value 5°C) from sowing to 1st July for flat soil and ridges on 5 cm depth in early sowing

Trial	Flat soil, TS	Flat soil, SD for TS	Ridges, TS	Ridges, SD for TS
Kristianstad 2008	1061	0.20	1062	0.20
Västerås 2008	637	0.19	690	0.33
Kristianstad 2009	798	0.22	777	0.21
Västerås 2009	560	0.19	556	0.20

SD=standard deviation

Statistical analysis was performed using the Mixed model procedure in SAS Version 9.3 (SAS Institute Inc. 2010).

Results and Discussion

There were no clear positive effects of using ridges when growing silage maize according to the results (Table 3). The only significant positive effect seen was on DM yield and DM content in Västerås 2008, but because of the very low yield with problems both at sowing and harvesting, this effect is not reliable. There was a large variation in this data. In 2009, there is a significant negative effect on the DM content at both sites, but this was not affecting the DM yield. Data from the other treatments are not shown here. The results show large differences between the two sites but sites were not compared statistically (Table 3). Västerås, which is in the northern area of where maize is grown in Sweden, had much lower yields of DM and starch than Kristianstad. Västerås had problems with either too dry or too wet conditions. There is a risk if the soil is too dry when making the ridge, as the germination in the ridge will be poor, but this was not seen in these trials. In 2009, the normal sowing time was delayed when waiting for rain (Table 1). The low yield in Västerås, especially 2008, was probably a combination of unfavourable rainfall conditions and lower temperature. There was a very small difference in the temperature sum between ridges and flat soil for the whole growing period and no general pattern was seen (Table 2). The hypothesis was that the ridges were heated up faster than flat soil and will have a higher soil temperature, which was not confirmed by the results. It could be expected that ridges could have a larger variation in temperature and this was only confirmed for Västerås with a slightly higher standard deviation for the hourly measured temperatures (Table 2).

Table 3. Yield and content of dry matter (DM) and starch with different soil treatments

Site	Treatment	DM, kg ha^{-1}	DM, %	Starch, kg ha^{-1}	Starch, %
Kristianstad 2008	Ridges	18 040	31.3	5 100	28.6
	Flat soil	18 490	32.6	5 555	30.2
	p-value	0.425	0.088	0.199	0.225
Västerås 2008	Ridges	5 200	36.0	800	15.1
	Flat soil	4 640	20.7	536	11.7
	p-value	0.039	0.360	0.402	0.833
Kristianstad 2009	Ridges	19 060	38.6	4 264	22.5
	Flat soil	19 120	40.3	4 285	22.5
	p-value	0.818	0.016	0.957	0.995
Västerås 2009	Ridges	10 040	20.1	738	7.3
	Flat soil	10 750	21.8	1 398	12.8
	p-value	0.114	<0.001	<0.001	<0.001

Conclusions

There were no positive effects of using ridges when growing silage maize. A negative effect on DM content was observed in the second experimental year.

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References

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