Faculty of Agronomy

Mendel University in Brno

14th ALPS-ADRIA SCIENTIFIC WORKSHOP

„MULTIFUNCTIONAL SOIL RESOURCES“

11th – 16th May 2015 Neum, Bosnia-Herzegovina

EFFECT OF ROW SPACING AND STAND DENSITY ON SILAGE MAIZE YIELD

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OP Vzdělávání pro konkurenceschopnost
INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

The participation was supported by project No. CZ.1.07/2.2.00/28.0302.

INTRODUCTION

Silage maize

- traditional fermented fodder for animals,
- biofuel feedstock for biogas stations (anaerobic digestion).

Number:

511 in 2014

Power:

392,35 MW

2020 – expected 720

INTRODUCTION

DEMANDS ON HIGH PRODUCTION, but it is influenced by:

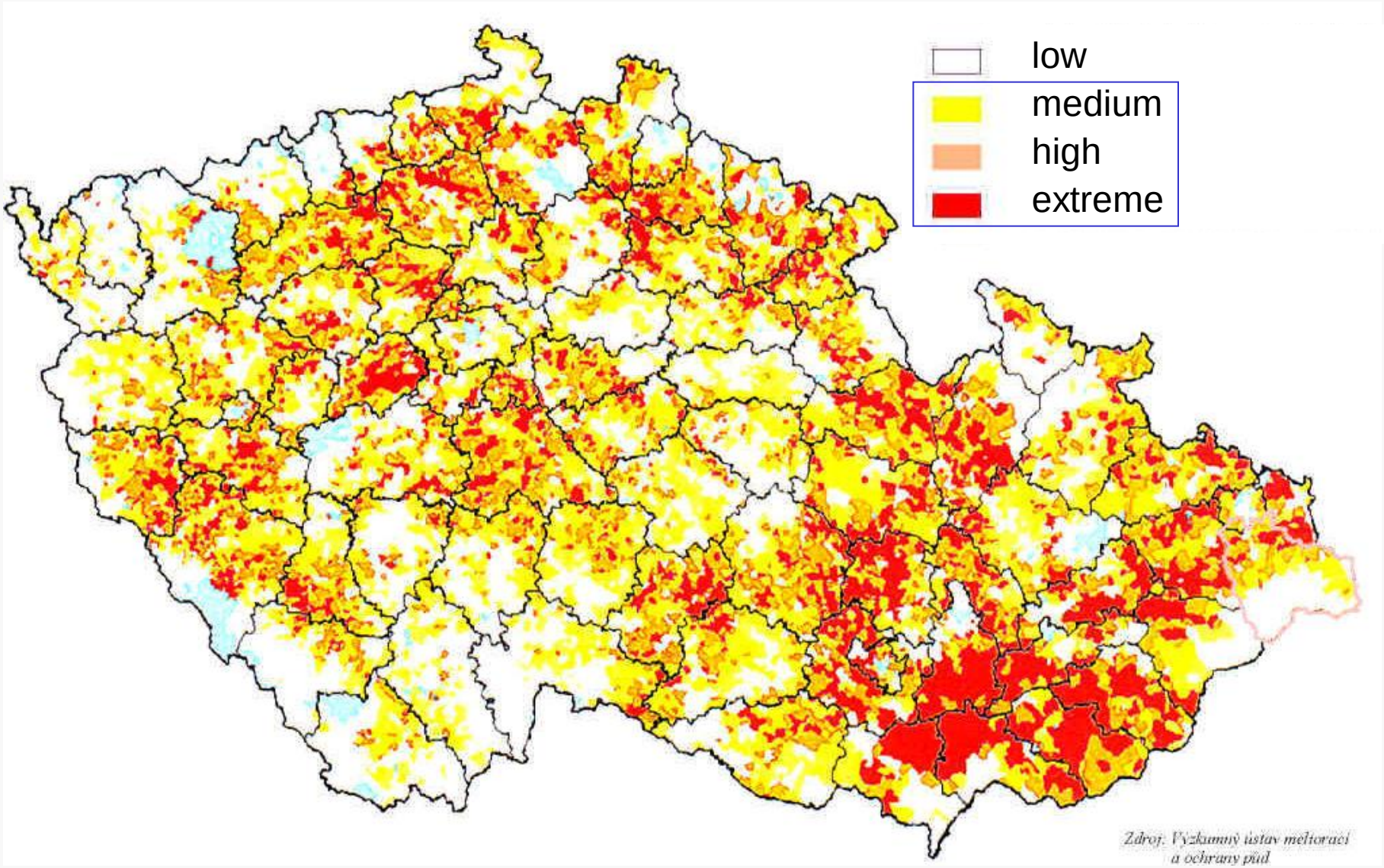
- various soil and climatic conditions in relation with an altitude,
- poor crop structure (wheat, barley, oilseed rape, maize …)

… and high risk of soil erosion - due to a wide-row crop and in combination with large field blocks in hilly areas

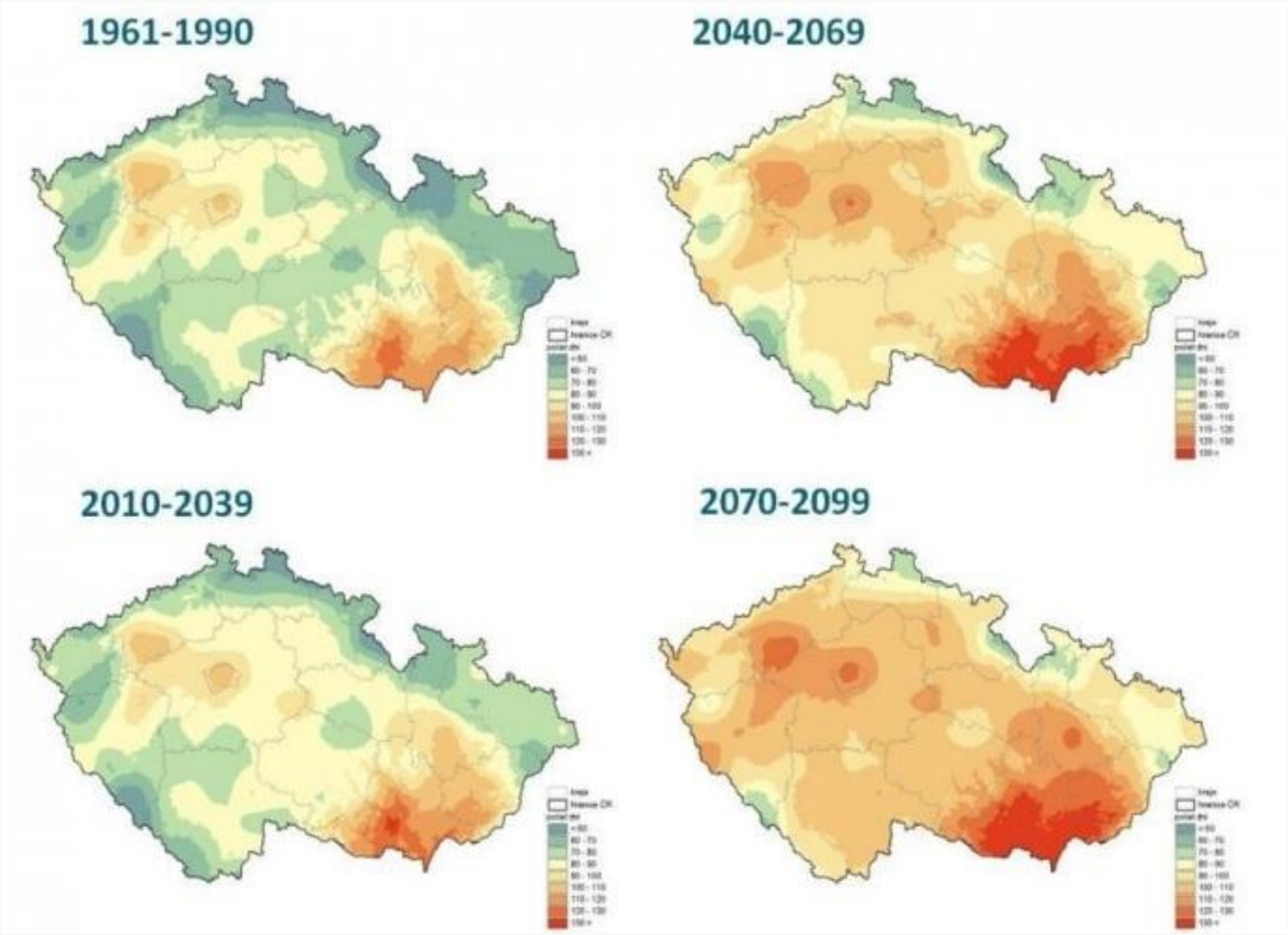
The goals for future are:

- **to innovate MAIZE CROPPING SYSTEMS,**
- **to manage PROFITABLE and ENVIRONMENT-FRIENDLY GROWING TECHNOLOGY.**

INTRODUCTION – areas with soil erosion risk



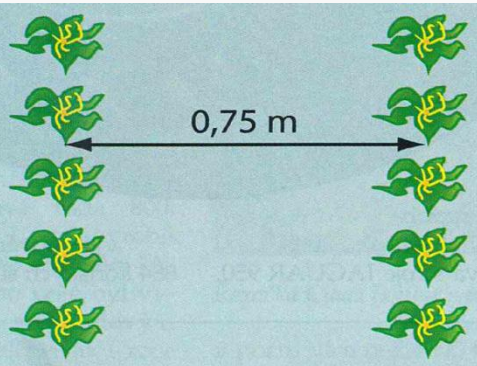
INTRODUCTION – areas with drought risk (climate change scenarios)



MAIZE CROPPING SYSTEMS – DIFFERENT ROW SPACING

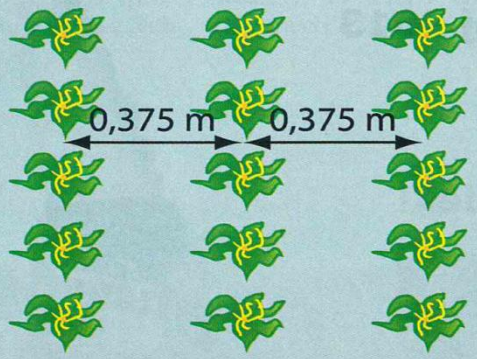
Standard

Maize
Sunflower
Sorghum



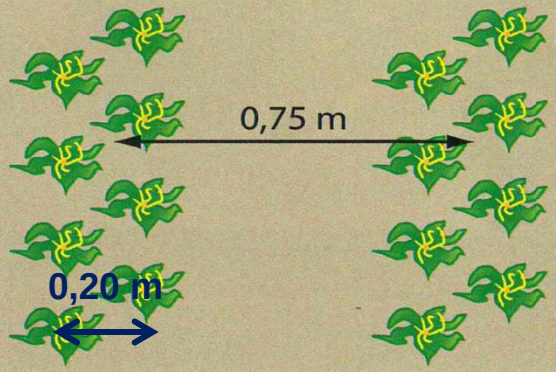
Narrow rows

Maize
Soybean
Oilseed rape
Sunflower
Sorghum



Twin rows

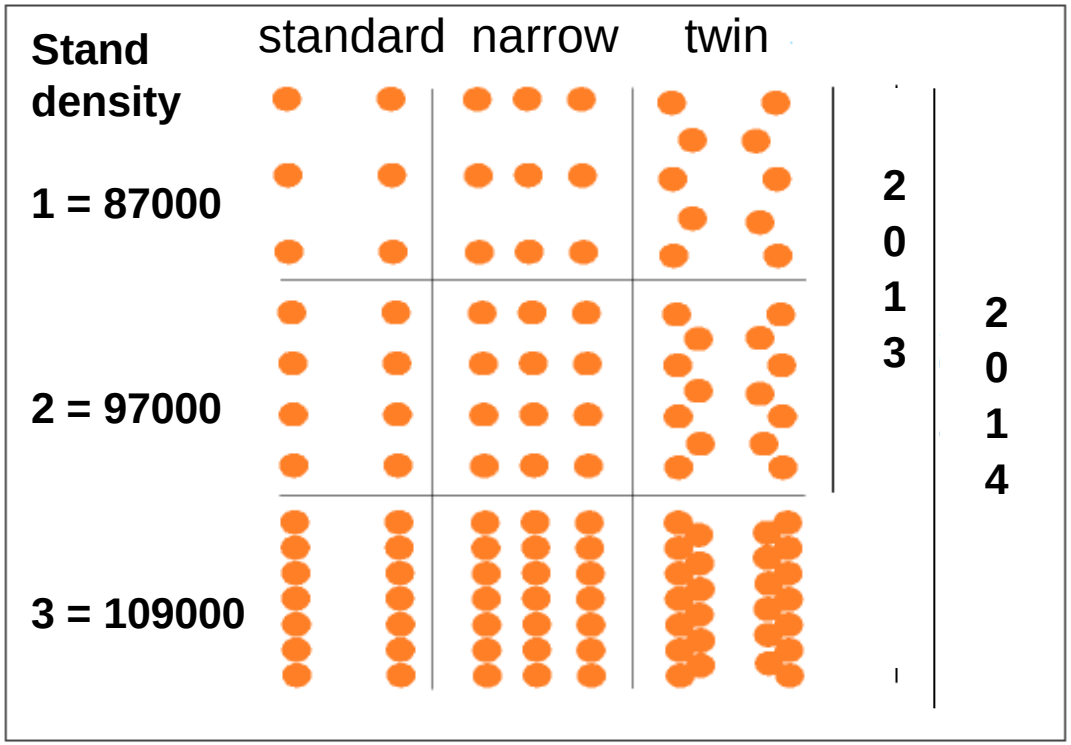
Grain maize
Silage maize



MATERIAL AND METHODS – field trial design

variant of rows

75 ----- 37.5 ----- 75



Hybrid FAO 280 (Syngenta)

SILOTOP (2013)

BEAUTIFUL (2014)

180 kg N in urea form

Date of sowing:

18. 4. 2013

14. 4. 2014

Herbicide – POST

Insecticide – *Ostrinia nubilalis*

Depth of sowing: 7 cm

Soil tillage: disking

Previous crop: winter wheat

Locality: Žabčice (South Moravia), 180 m a.s.l.; 9,2 °C; 480 mm

Soil: fluvisol, clayey

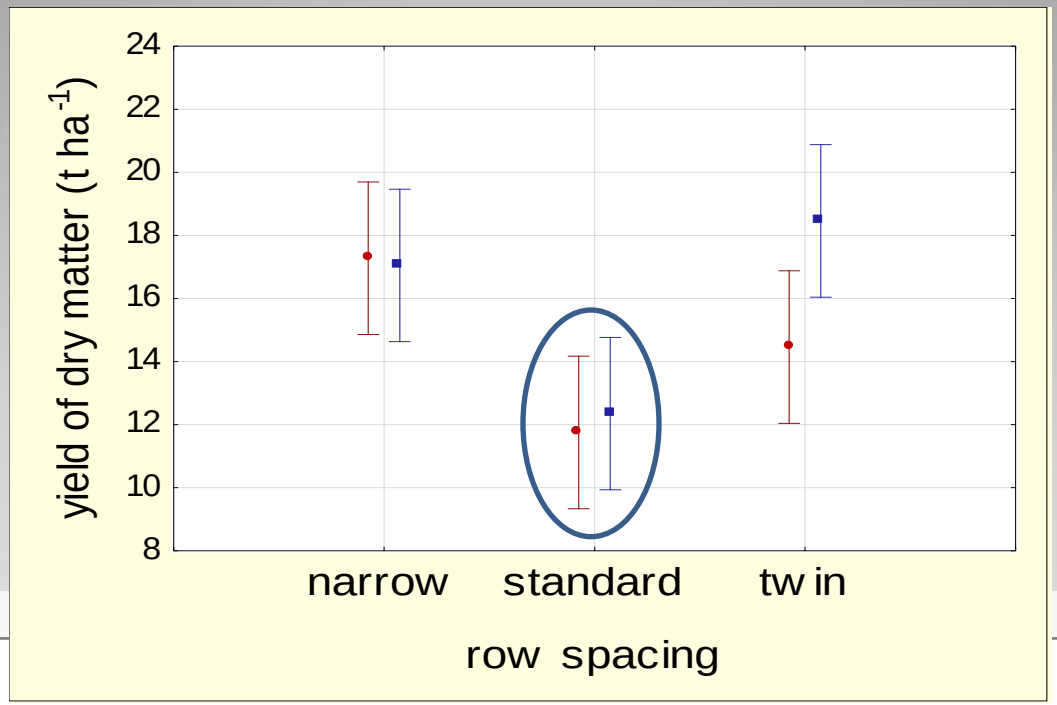
MATERIAL AND METHODS

KINZE 3500 – drilling machine for precise sowing

Assessment	2013	2014
Growth dynamic	no	yes
Yield (t/ha, biomass, milky-waxy ripeness	yes	yes
Biomass quality and biogas production	yes	no
Soil moisture, temperature measurements	yes	yes

RESULTS

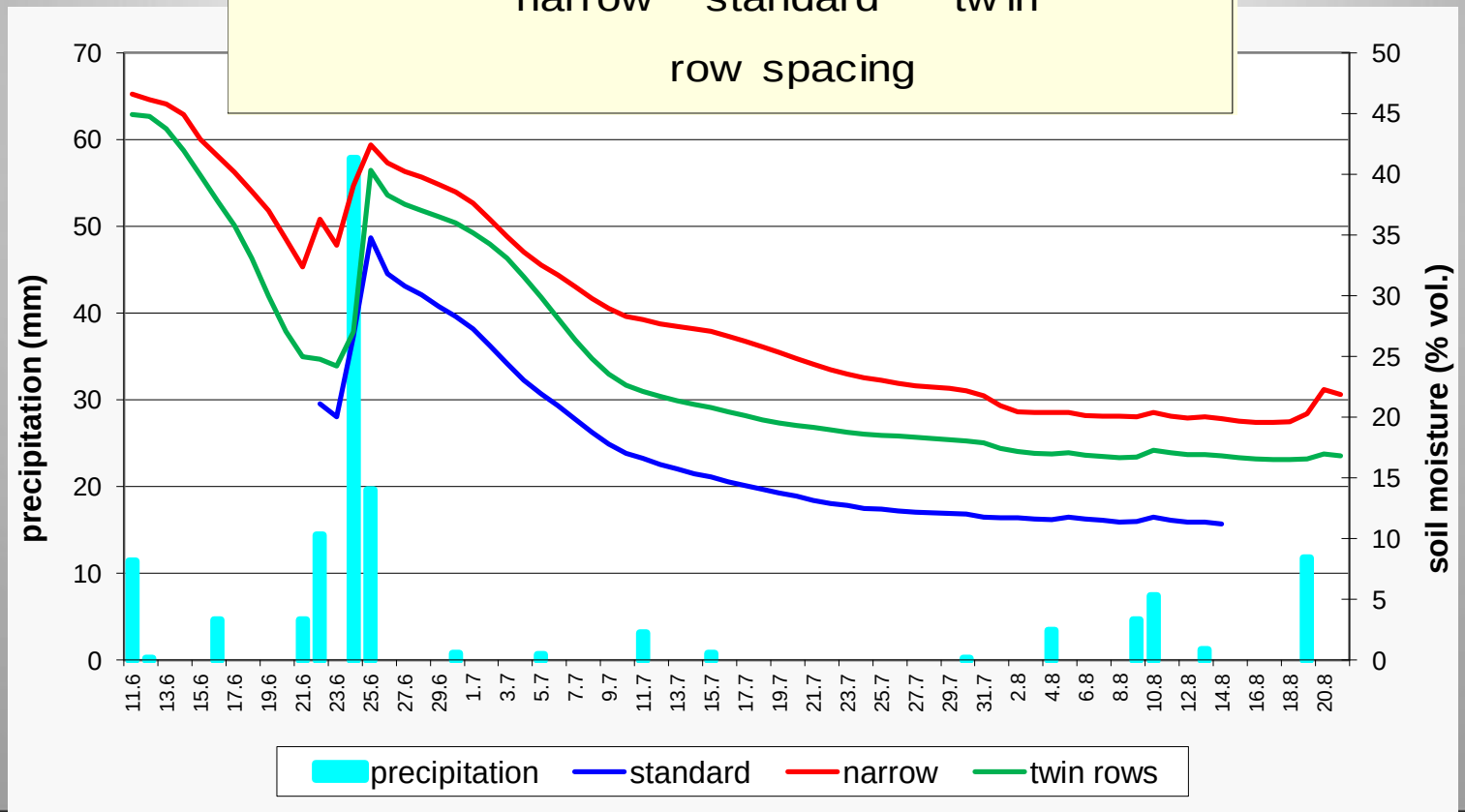
Year 2013



yield

stand density 1

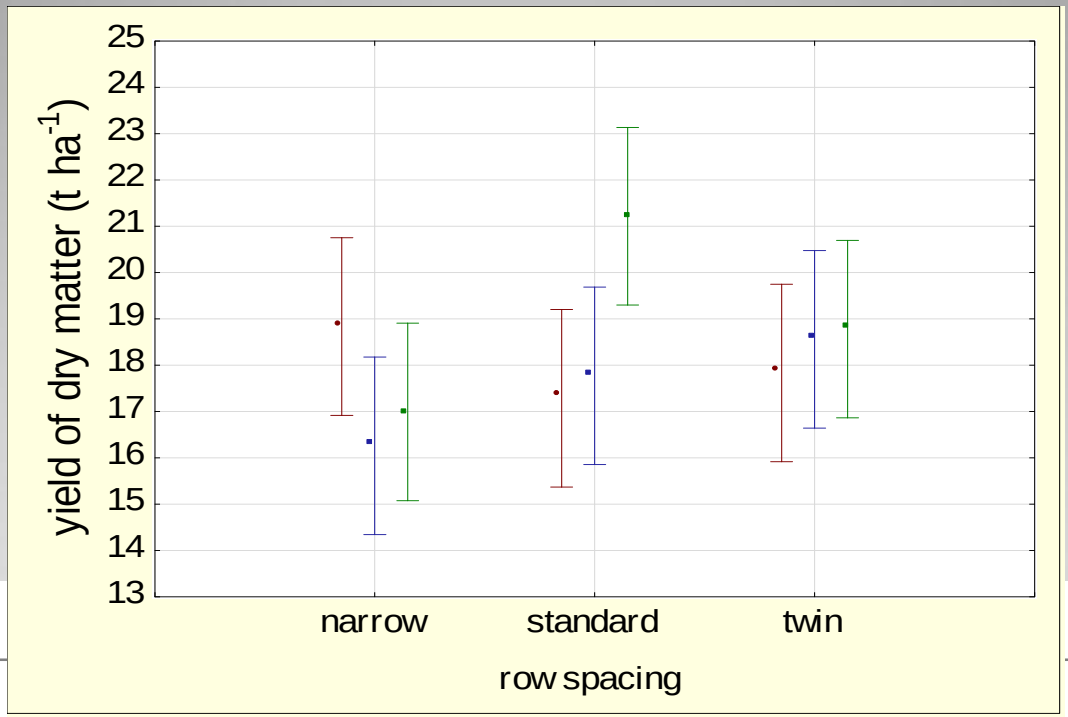
stand density 2

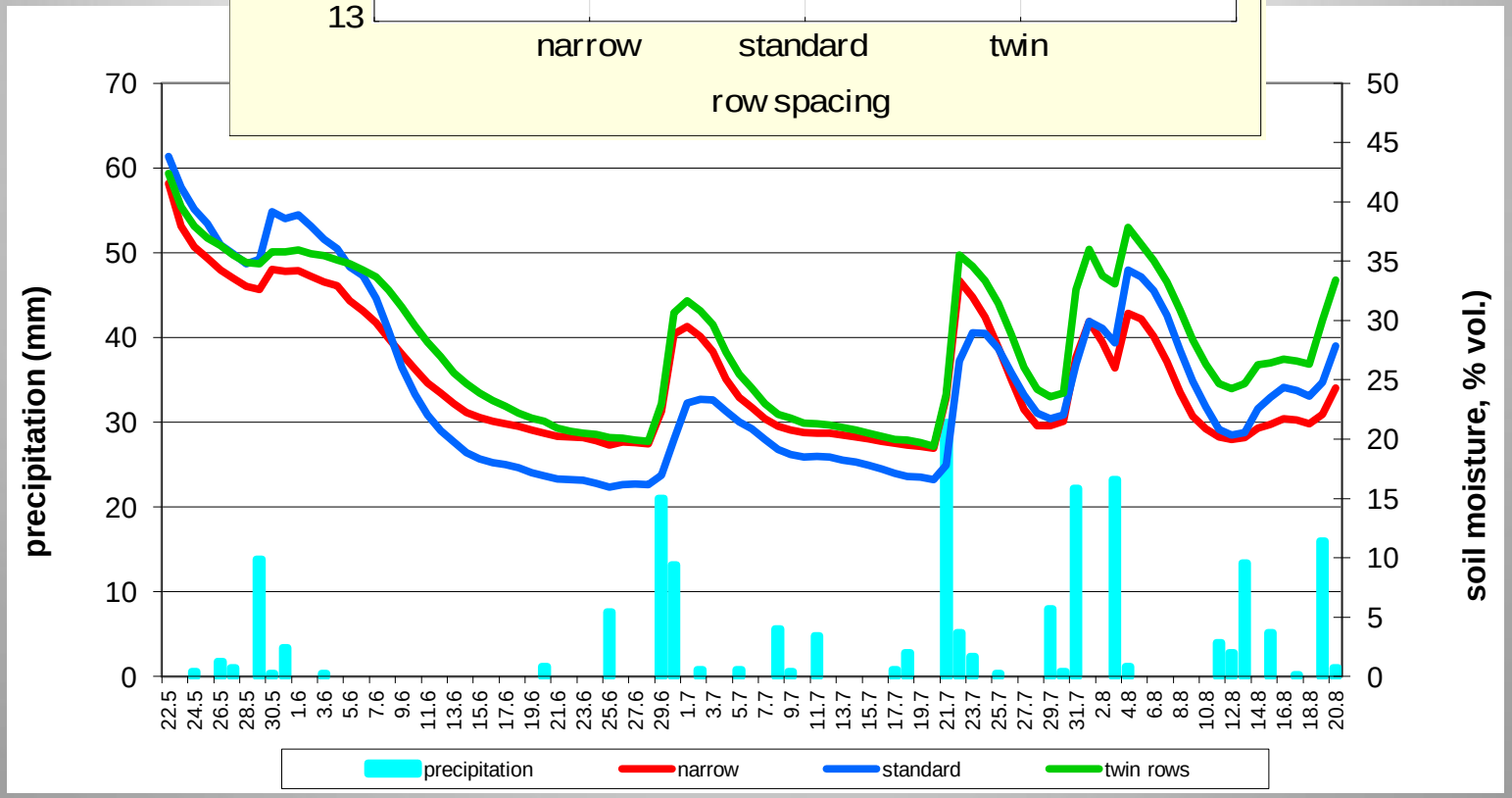


RESULTS

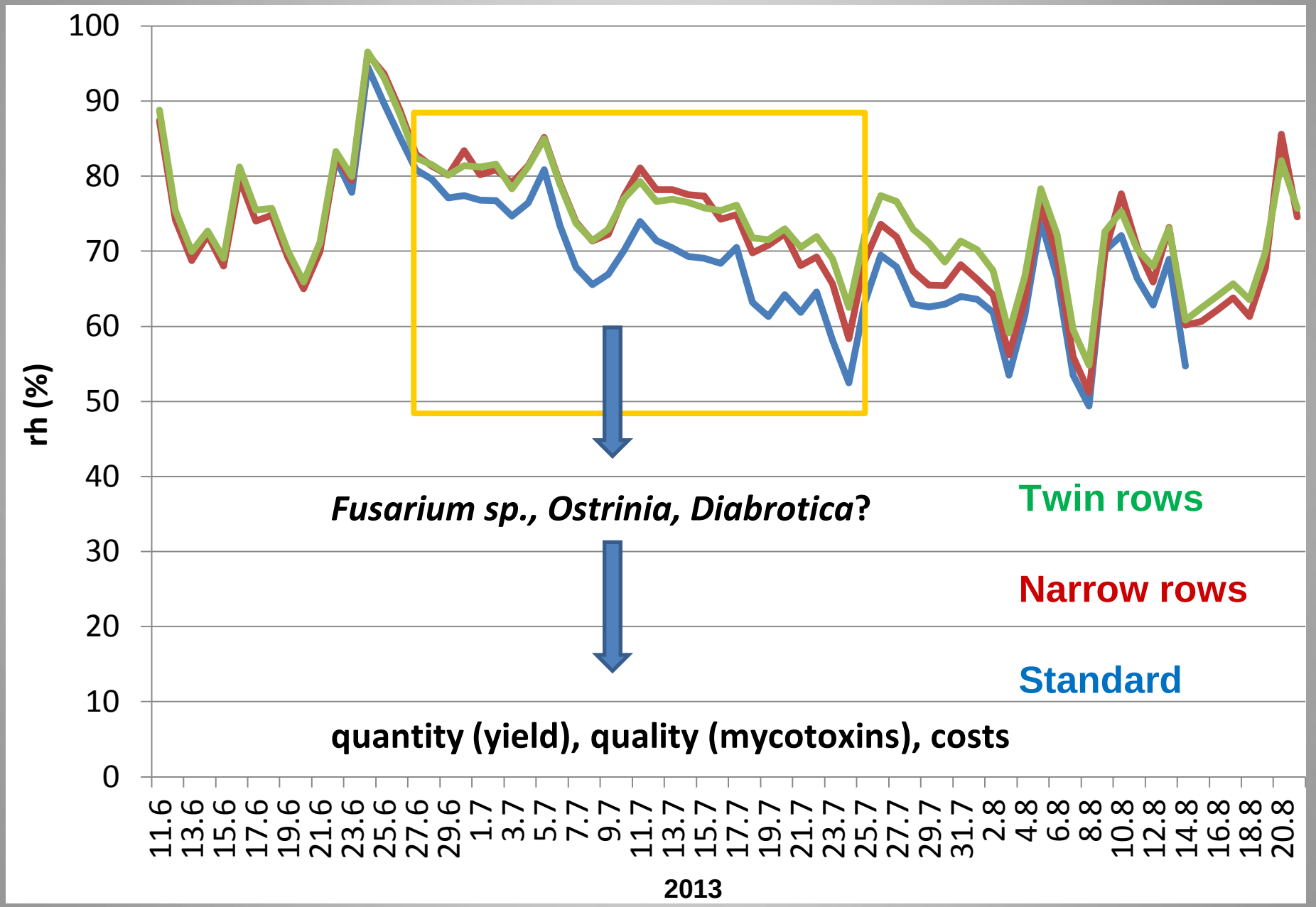
Year 2014

yield

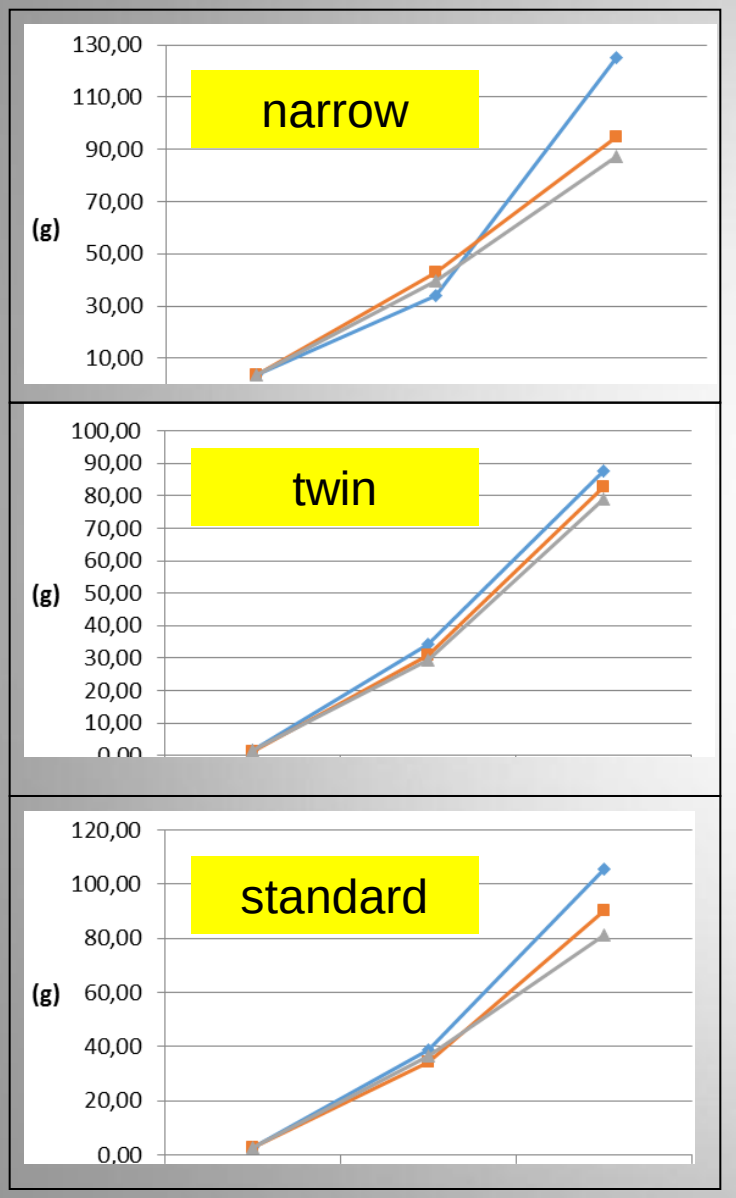




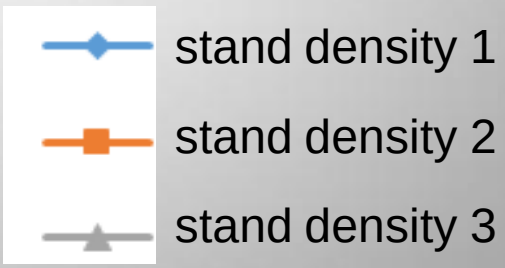
RESULTS – relative air humidity in maize stand in different row spacing



RESULTS – growth dynamic (2014)



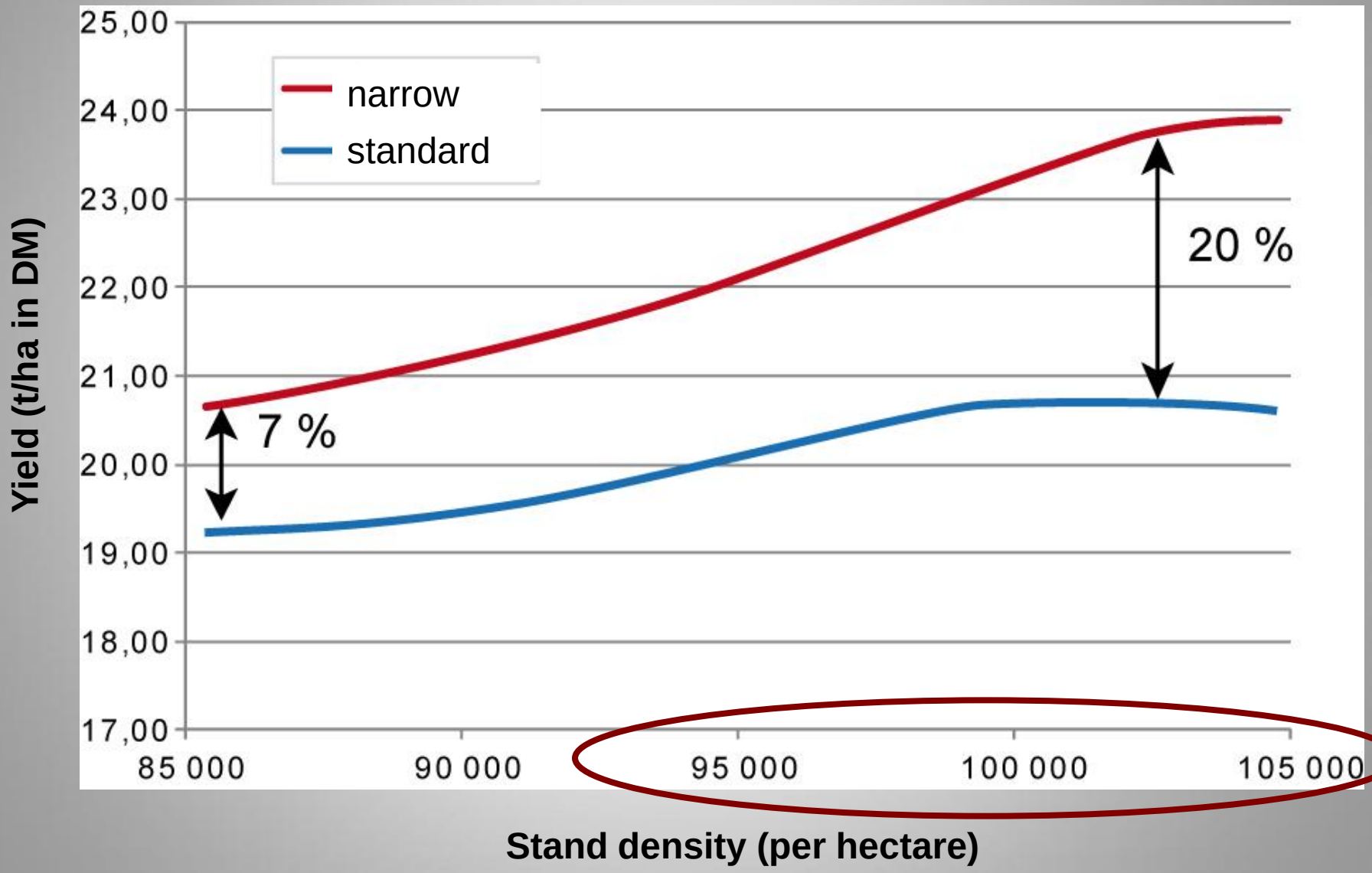
Parameter	variant	stand density		
		1	2	3
Height of plants (cm)	narrow	255	237	240
	standard	236	238	243
	twin	252	247	248
Stem diameter (mm)	narrow	19,5	18,9	19,0
	standard	19,4	18,2	18,1
	twin	19,7	19,0	19,3
Height of ear (cm)	narrow	104	97	100
	standard	96	98	100
	twin	100	101	96
Proportion of main stem (%)	narrow	91	95	97
	standard	90	97	99
	twin	95	89	97
Proportion of ears (%)	narrow	37,3	43,4	39,0
	standard	37,9	37,9	40,3
	twin	37,9	35,9	39,7



RESULTS – qualitative analyses of silage biomass (2013)

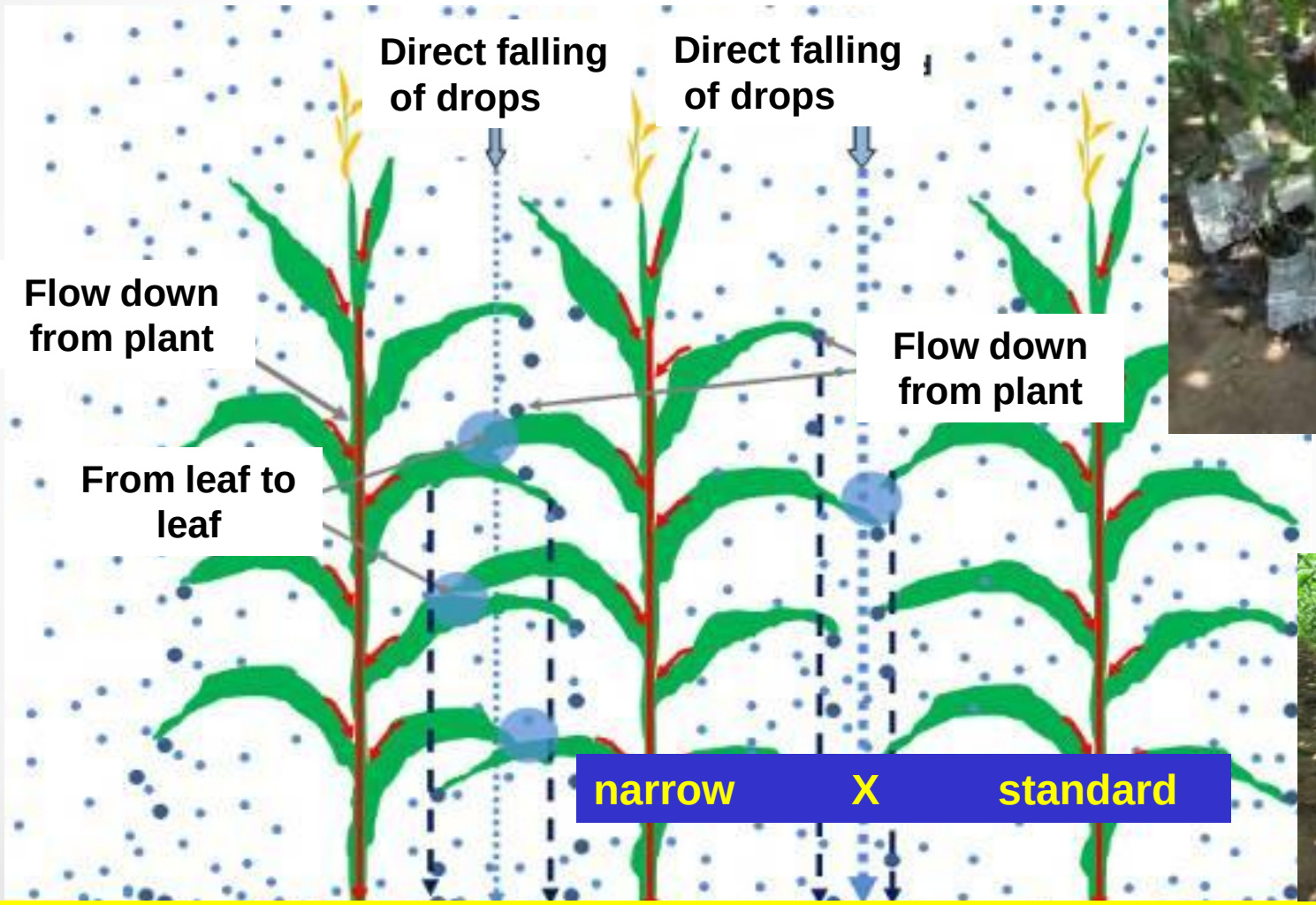
Variant	standard		narrow		twin	
Stand density	**1**	**2**	**1**	**2**	**1**	**2**
Dry matter (DM; %)	34,05	**38,92**	37,78	**38,61**	35,45	35,58
Proteins in % DM	8,62	8,57	8,58	8,49	8,45	8,66
Crude fibre in % DM	19,82	20,01	19,79	**21,40**	19,64	**22,50**
Ash in % DM	4,88	4,95	4,87	**5,90**	4,52	**6,77**
Starch in % DM	28,31	27,77	29,38	28,56	28,40	27,73
Biogas production in l/kg DM	608,5	569,7	587,9	598,2	567,0	576,9
Methan production in l/kg DM	311,6	300,8	306,3	306,3	304,5	298,4
% of methan	51,2	52,8	52,1	51,2	53,7	51,8
Yield (t/ha) in DM	12,59	13,38	16,11	**17,05**	14,01	**18,46**
Biogas production (m^3/ha)	7661	7623	9471	**10199**	7943	**10650**
Methan production (m^3/ha)	3923	4025	4934	**5222**	4266	**5508**

RESULTS – trends in yield (trials on farms, 4 years, 25 trials)



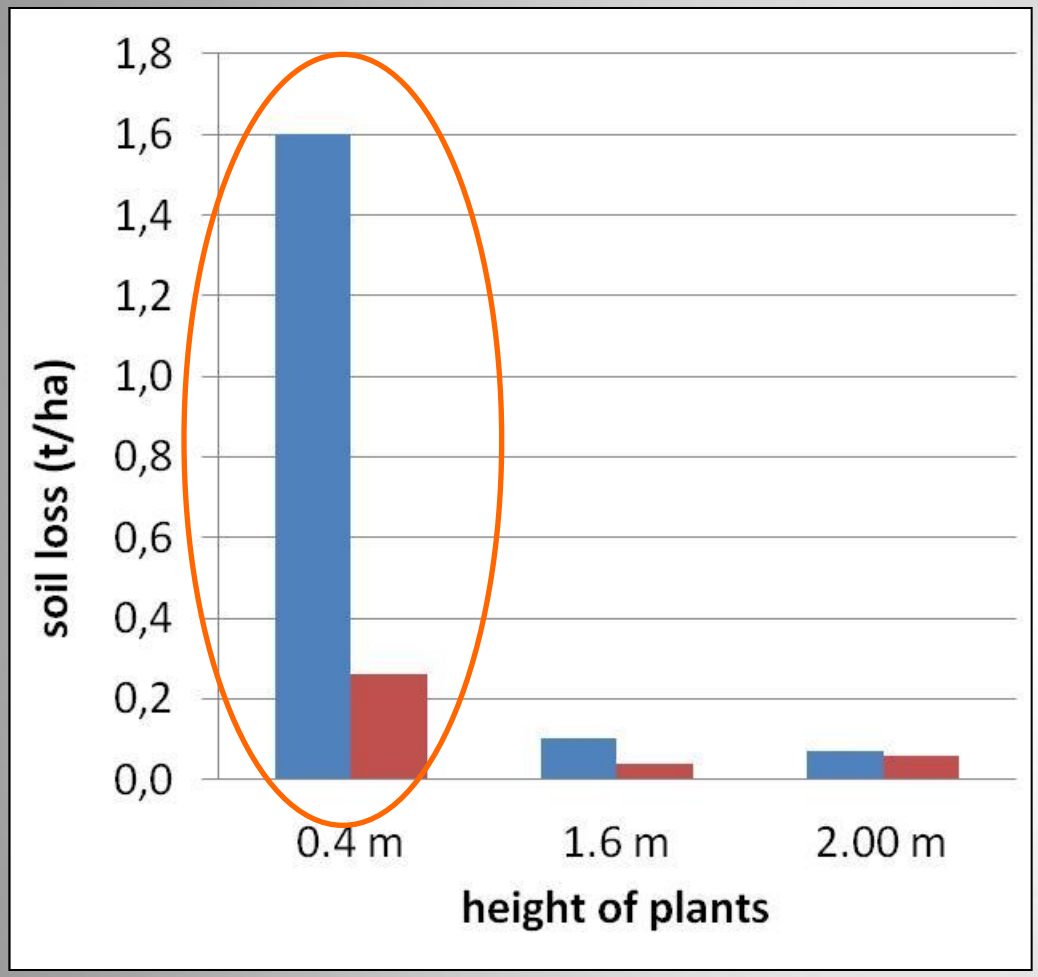
RESULTS – study of water erosion reduction

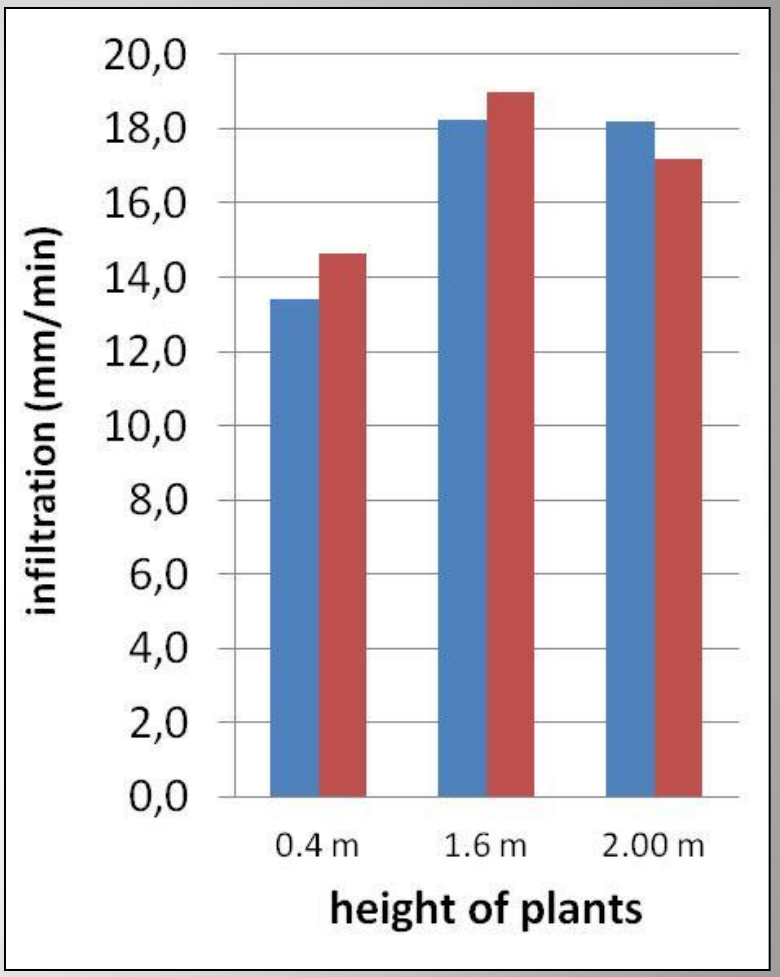
Distribution of rain drops on maize canopy



Direct falling was reduced to about 75 % in narrow rows (Brant, 2013)

RESULTS – soil losses and infiltration of water into the soil





narrow standard

Herout, 2015

Conclusion

Growing of silage maize in narrow rows (37.5 cm):

- is intensive water-saving technology with positive effect against water erosion,
- brings comparable or higher yields (in comparison to standard rows),
- applicable in other crops, e.g. oilseed rape.

Topics for further research:

- response of various hybrids,
- interaction with different soil tillage systems (conservation tillage) and other agronomic practice (inter-crops …)

In general, it is necessary to optimize usage of digestate in system which improve soil fertility from long-term point of view.

Thank you for your attention