Paper No. 991149

Local Yield Measurement in a Potato Harvester and Overall Yield Patterns in a Cereal-Potato Crop Rotation

by

Demmel M., Auernhammer H.

Institut für Landtechnik, Technische Universität München
Freising· Weihenstephan, Germany

Written for Presentation at the
1999 ASAE/CSAE-SCGR Annual International Meeting
Sponsored by ASAE/CSAE-SCGR

Sheraton Centre Toronto Hotel
Toronto, Ontario Canada
July 18-21, 1999

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Introduction

Local yield detection is widely recognized as basic information for management decisions in site-specific plant production or for controlling the effects of spatially variable applications.

For yield measurement in combine harvesters commercially available equipment is on the market and has been evaluated under different practical conditions as well as on a test stand.

For determination of yield patterns into stable yield zones local yield data for more than two seasons are necessary.

To get the needed information as fast as possible local yield detection for non- combinable crops of typical European rotations is an indispensable requirement.

For forage choppers, different developments have been reported. Also for the yield monitoring of "conveyor harvested crops", like sugar beets, potatoes, onions and tomatoes, first technical solutions are available.

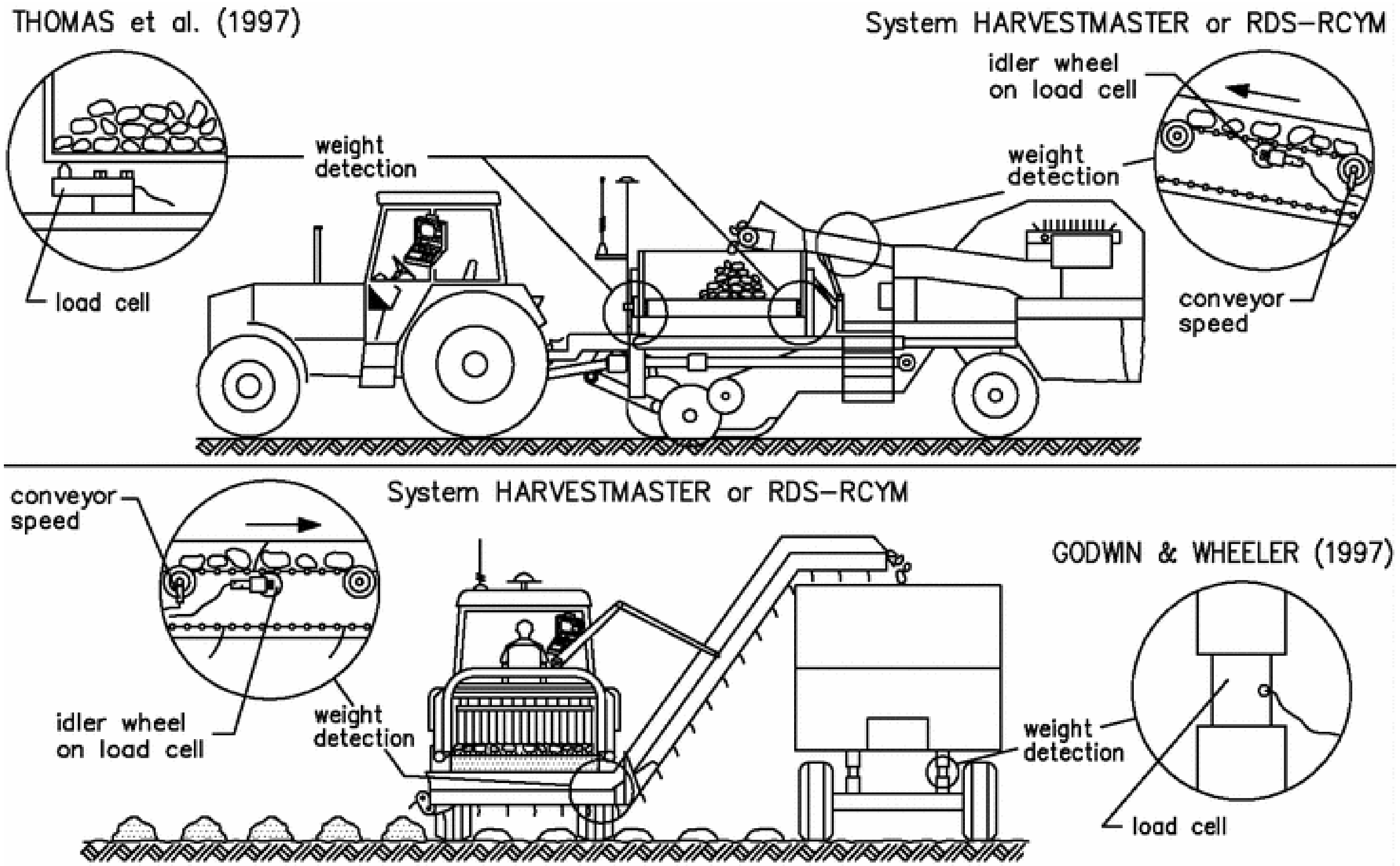
For yield measurement of sugar beet conveyor weighing systems a mass-flow system measuring the forces on a curved plate (side screen) at a rotating spinner or a laser based optical volume flow measuring system have been proposed.

For potato harvesters, only the application of a conveyor weighing technique has been reported. The systems have been installed into the trailer loading elevator of two- or four-row harvesters.

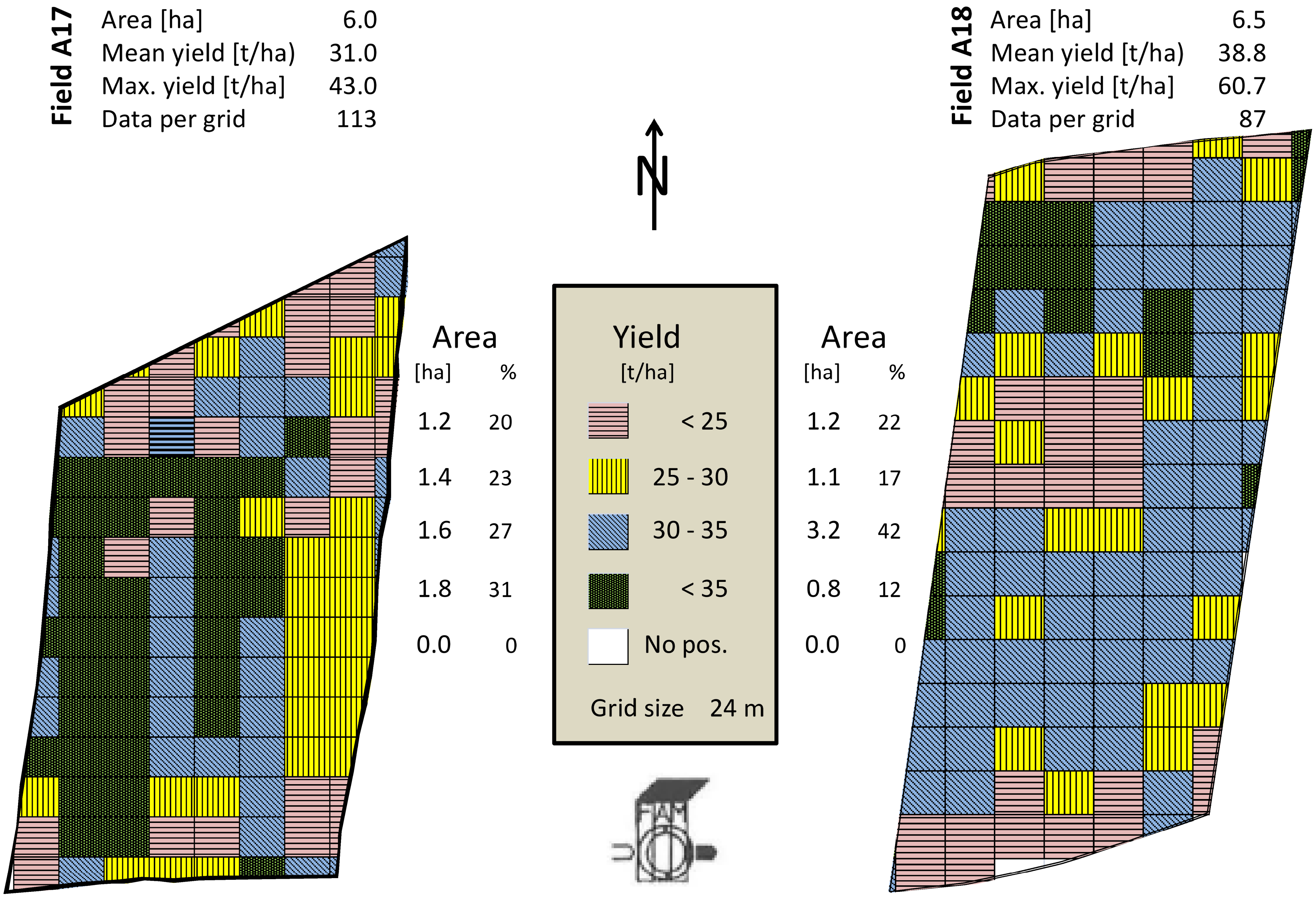
In Germany, single-row machines with a bunker-hopper are used. To get knowledge on the accuracy of a yield detection system under such conditions a measurement system for local yield detection was evaluated in the potato harvest seasons 1997 and 1998.

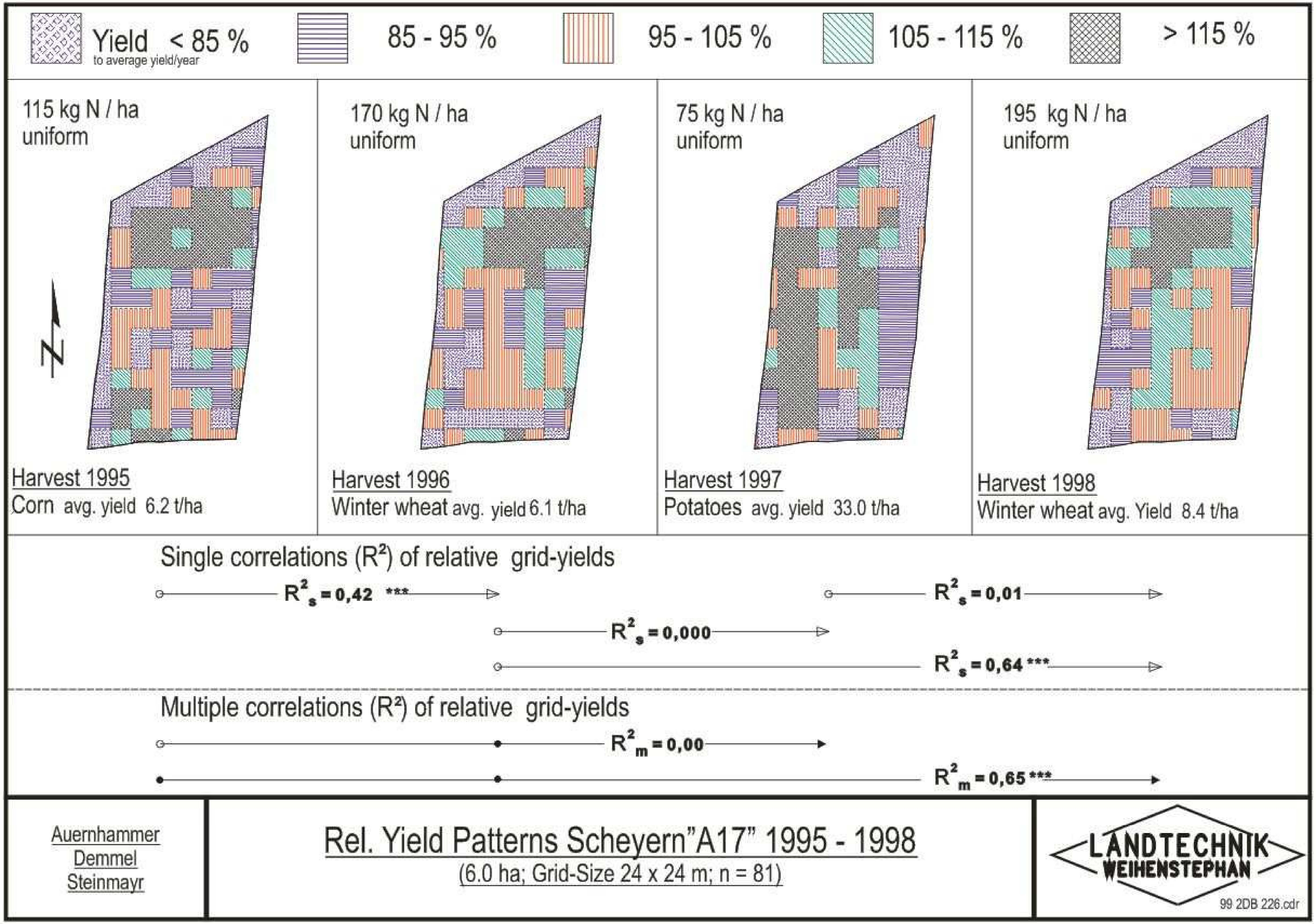
Material and Method

Based on the typically used harvester technology, the following mass-flow and yield measurement systems can be considered:



Yield maps potato fields experimental farm Scheyern 1997




Yield < 85 %
to average yield/year
85 - 95 %
95 - 105 %
105 - 115 %
> 115 %
115 kg N / ha
uniform
170 kg N / ha
uniform
75 kg N / ha
uniform
195 kg N / ha
uniform
N
Harvest 1995
Corn avg. yield 6.2 t/ha
Harvest 1996
Winter wheat avg. yield 6.1 t/ha
Harvest 1997
Potatoes avg. yield 33.0 t/ha
Harvest 1998
Winter wheat avg. Yield 8.4 t/ha
Single correlations (R²) of relative grid-yields
R²s = 0,42 ***
R²s = 0,01
R²s = 0,000
R²s = 0,64 ***
Multiple correlations (R²) of relative grid-yields
R²m = 0,00
R²m = 0,65 ***
Auernhammer
Demmel
Steinmayr
Rel. Yield Patterns Scheyern"A17" 1995 - 1998
(6.0 ha; Grid-Size 24 x 24 m; n = 81)
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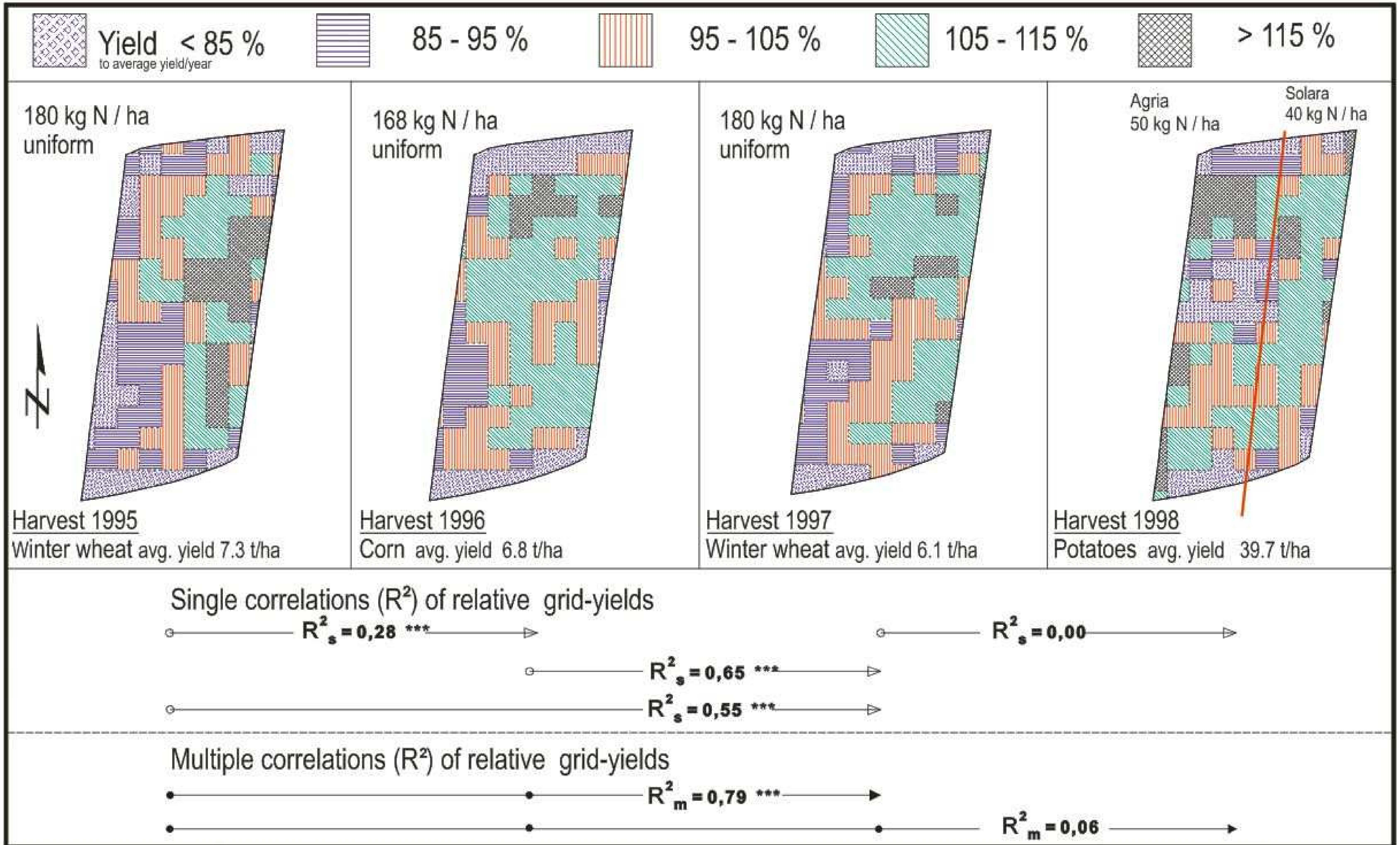
99 2DB 226.cdr



Auernhammer
Demmel
Steinmayr

Rel. Yield Patterns Scheyern "A18" 1995 - 1998

(6.5 ha; Grid-Size 24 x 24 m; n = 88)

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Accuracy of mass-flow and yield measurement systems for potatoe and sugar beet harvesters

measurement principle	Harvester typ, crop	author	evaluation extend	measured accuracy
mass accumulation System “Silsoe”	Trailer Sugar beet, potatoes	Godwin et al. 1997	1 field 15 loads	avg. = 1.1 % s.d. = 4.0 %
basket weighing System “Tifton”	Trailed two-row baske combine, peanuts	Durance et al. 1998	2 field 40 loads	avg. = 0.2 % s.d. = 3.1 %
conveyor weighing “Harvestmaster”	trailed two-row side loading, potatoes	Rawlins et al. 1995	1 field 48 loads	avg. = n.c. s.d. = 4.9 %
conveyor weighing “Harvestmaster”	trailed six-row side loading, sugar beet	Hall et al. 1997	1 field 99 loads	avg. = 0.97 % s.d. = 2.2 %
conveyor weighing “Harvestmaster”	trailed six-row bunker hopper, potatoes	Demmel et al. 1998	2 field 77 loads	avg. = 1.3 % s.d. = 4.1 %
conveyor weighing “Harvestmaster”	self-propelled six-row side-loading, sugar beet	Demmel et al. 1998	2 field 39 loads	avg. = 1.0 % s.d. = 3.7 %
conveyor weighing system “Rottmeier”	self-propelled six-row tanker, sugar beet	Demmel et al. 1998	5 field 23 loads	avg. = 2.1 % s.d. = 5.6 %
force curved plate system “Leuven”	self-propelled tanker loader, sugar beet	Broos et al. 1998	1 field 19 loads	avg. = 0.4 % s.d. = 1.6 %
laseroptical volume system “Bonn”	self-propelled cleaner loader, sugar beet	Kromer et al. 1998	2 field 15 loads	avg. = n.c. s.d. = 4.0 %

Conclusions

Local yield detection using conveyor weighing technique on a one-row trailed potato harvester with offset-lifting and bunker-hopper using DGPS for positioning worked without any technical problem during two harvesting seasons.

The reached accuracy was comparable to the accuracy of yield measurement in combines and to other measurement systems for "conveyor harvested crops".

Errors difficult to estimate arise from contaminants (halm, clods, stones) which are collected and "weighed" together with the crop. A post-harvest data correction with an estimated or calculated "average" contaminant content will not be able to solve that problem, especially if the proportion of the contaminants is changing within the field.

Additional measuring systems to determine the contaminant content will be needed in future, also to automatically control the cleaning process in the harvester.

First comparisons of potato yield maps to those of combinable crops show deviating yield patterns. Further analysis on whole rotations, more fields, over several years and at more locations are needed to confirm this observations.

Acknowledgements

The evaluation of the yield measurement system on a trailed single-row, offset-lifting, bunker-hopper potato harvester was part of project No. A7 "Precision farming technique" of the 1995-1997 period of the research network Forschungsverbund Agrarökosysteme München (FAM).

The scientific activities of the research network Forschungsverbund Agrarökosysteme München (FAM) are financially supported by the Federal Ministry of Research and Technology (BMBF 0339370). Rent and operation of the experimental farm Scheyern are paid by the Bavarian State Ministry for Education and Culture, Science and Art.