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Several Years Experience with Site-specific Fertiliser Application and Harvesting

Site-specific farming adjusts cultivation measures to the changing conditions on small sites and aims at achieving higher input efficiency through suitable technology, as well as an increase in yield and quality. About several years experience with site-specific fertiliser application is reported in the following.

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Keywords

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Literature

Literature references can be called up under LT 03402 via internet http://www.landwirtschaftsverlag.com/landtech/local/literatur.htm.

The centrifugal distributor has proved itself because the distribution pattern leads to sliding transitions between the transverse and longitudinal application when the amount of nitrogen changes. The rectangle distribution of a pneumatic distributor leads to strong differences in the transverse direction. Under research conditions this kind of distributor has the advantage that the amount of fertiliser can clearly be assigned to the sites.

The longitudinal and transverse distribution should not depend on the flow rate. It varies in a 1:15 ratio depending on the amount of fertiliser e.g. 20 to 100 kg N/ha as well as with speed, e.g. 5 to 15 km/h. New and well adjusted machines show a coefficient of variation of 4 to 7%. Data can be found in the DLG-examination [10, 13].

The longitudinal distribution depends on the reaction time of the actuator and with that the distance, which is needed to regulate the amount of fertiliser. In specially set up experiments the reaction time and the distribution pattern were examined [11, 14]. At a given border the amount of calcium ammonium nitrate was varied from 0 to 150 kg/ha and the amount applicated was collected in examination trays 0,5 • 0,5 m (*Fig. 1*). The change between the two extremes runs over a distance of 15 m, depending on the speed of the tractor and of the actuator. According to the model the running time of the actuator lies between 3 and 12 sec.

The N-fertilisation depends on the estimated yield expectation for the soil and the crop. These factors depend also on a variety of factors, which again depend functionally on each other [6, 12]. But only some of these factors can be measured with reasonable effort. Therefore some first principles arise in order to define the N-application.

Empirical models are based on historical data, e.g. long term climate data mainly differentiated for soil and variety. As an example, the Nprog method developed by Hanus und Schoop in Kiel has been used in this research project [17 - 21]. Process orientated models take in growth depending parameters during the vegetation period, e.g. moisture, temperature or the mineralisation rate of organic nitrogen. Using the field assessment (done by a field-crop consultant or a farmer) the actual crop parameters and physiological development of the plants are taken more precisely into account, additionally to the soil and relief [1, 2, 3, 4, 9, 23]. An advisor is able to evaluate the importance of single parameters out of the multitude parameters in the field.

The reflection has a practical consequence, there is a reliable linear relationship between the nitrogen supply and the measurement. This can be used on-line to gauge the nitrogen application. Therefore this system is called "N-Sensor" by the industry ("Kieler System") [8, 15, 16, 22, 24].

Several strategies were used to fertilise site-specific, compared to customary fertiliser application. The uncertainty about the right amount of nitrogen led to the variants of increasing resp. decreasing it by 20 %. These variants are differently realised in the individual fields and are analysed together.

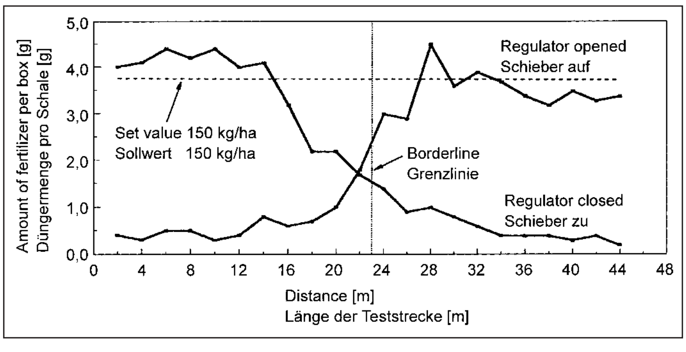

Fig. 1: Longitudinal distribution of fertiliser when opening and closing the feed shutter (Bredal B2, 9.6 kph)

Results of the site-specific fertilisation

In the literature one finds these two effects: more yield and reduction of fertiliser.

The experiments for this study were carried out in arable farms. The synopsis of several years compares site-specific with customary fertilisation, which is adapted to area specific extremes, e.g. valleys. The variants base on the recommendation of the consultant, concerning relief, crop, the Nprog model as well as reflection measurements (*Table 1*).

The yield and N-application are shown as means of the whole field as well as of the different sites (Table 1). Particularly remarkable is:

- same or even higher yield at reduced N-application
- same N-application and different yields
- increased N-application and decreasing yield

This overall result does not lead to a clear direction and there is no preference for a N-strategy.

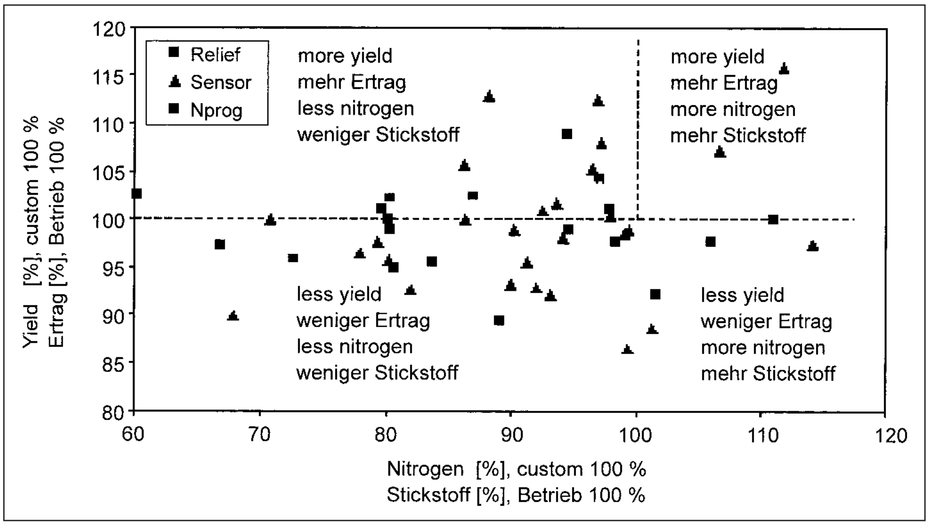

Fig. 3: Comparing site-specific fertilisation and yield versus farm data: several years and crops with different fertilising strategies

Further analyses are possible because the N-application varies and identical sites can repeatedly be found on one field. The N-application is correlated with the yield of the sites (*Fig. 2*). One can clearly see that the "poor" soils - less "soil points" and more sand - have a lower yield than the "rich" soils. The yield optimum on loamy sand (e.g. ls39, Fig. 2) is reached with a N-application rate of 130 kg/ha. Because of the site-specific fertilisation, a higher application of nitrogen is not carried out on this site.

From 1996 to 2002 experiments with site-specific fertilisation and yield mapping were carried out on several locations for indifferent crops. The results are compared to a customary variant, which is set at 100% (*Fig. 3*). In general one can see that decreasing N-applications do not lead to a decrease in yield - the yield is similar to the customary yield.

The variants using the sensor showed higher deviations than the variants depending on the relief.

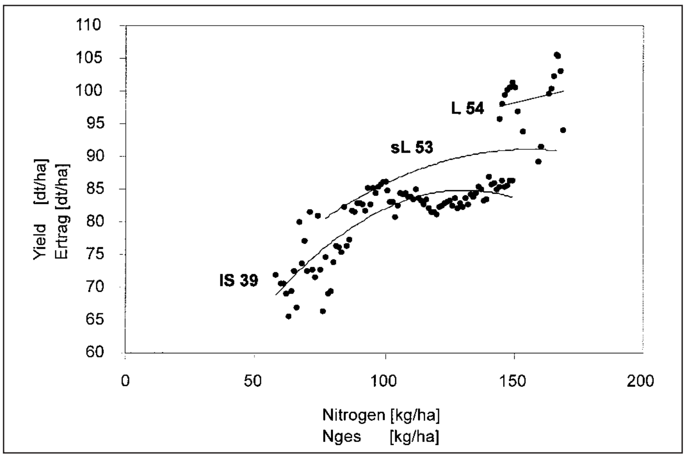

Fig. 2: Yield functions on different part fields, winter barley 1998

Table 1: Fertilising variants and yields over several years

	1997		2000		1998		2001		2002		1999		2001	
	Achterkoppel										Niedeel			
	WW				WB				Rape		WB		WW	
N-variant	N kg/ha	Yield dt/ha	N kg/ha	Yield dt/ha	N kg/ha	Yield dt/ha	N kg/ha	Yield dt/ha	N kg/ha	Yield dt/ha	N kg/ha	Yield dt/ha	N kg/ha	Yield dt/ha
Customary	196	110	237	97	161	83	159	88	116	37	171	98	226	113
Relief specific	164	105	191	92	129	83					169	95		
Relief decreased	131	107			97	85					153	87		
Relief increased					152	90,3								
Nprog			230	101							174	90		
Sensor							148	81	115	36			209	114
Sensor decreased							145	84	93	35			176	109
Sensor increased							161	78					258	110
Sensor N3Quality									115	32			195	113

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