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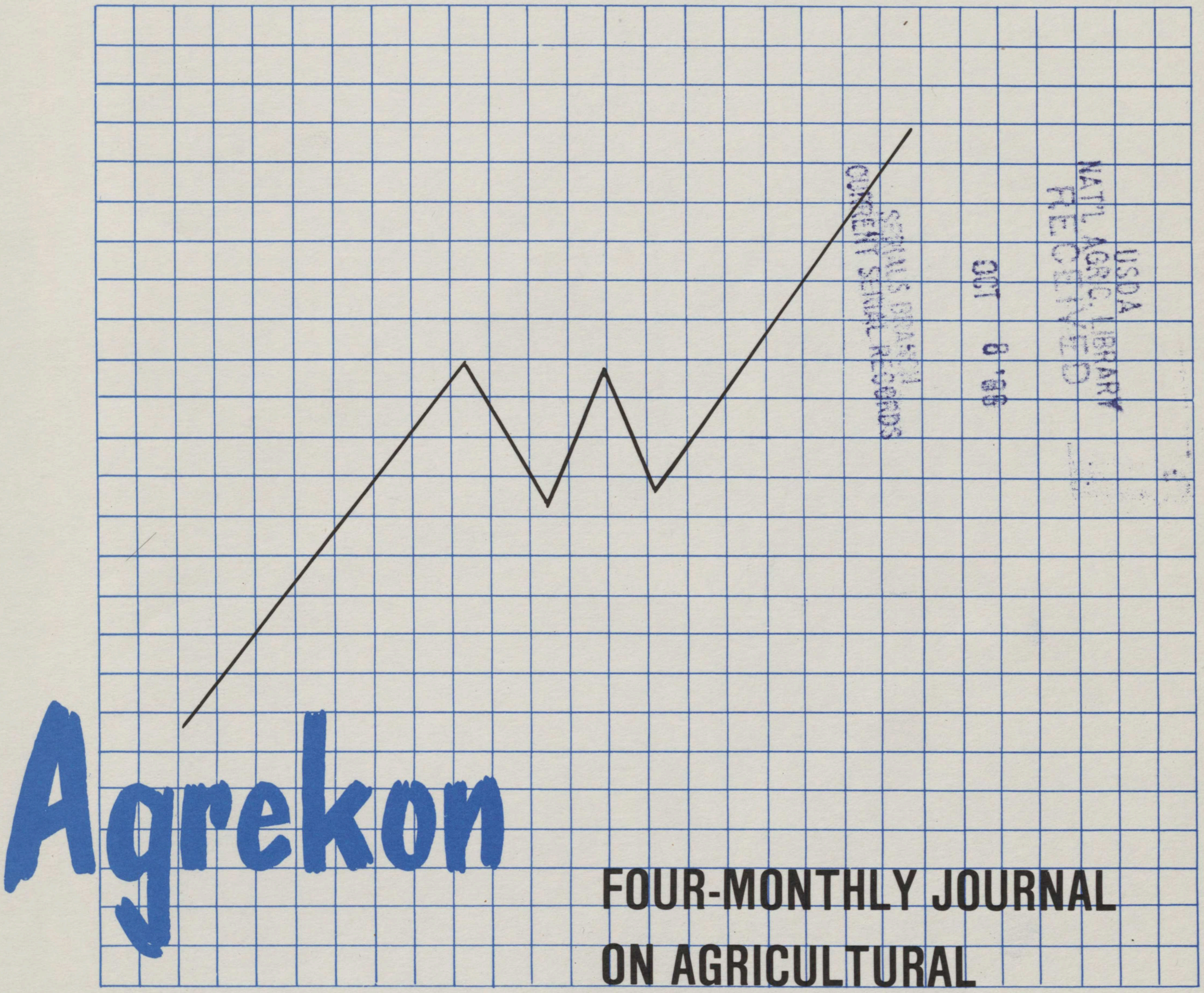

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THE DETERMINATION OF DIFFERENTIAL ECONOMIC OPTIMUM FERTILISATION LEVELS FOR DIFFERENT MAIZE CULTIVARS*

by
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ABSTRACT

Individual maize cultivars may react differently to fertilisation. Thus differential fertilisation levels can potentially have a marked influence on profitability of maize production and also on optimal cultivar selection. Fertilisation trials are not normally cultivardirected. The effect of fertilisation on a cultivar can thus not be directly determined.

Adaptation regression lines of cultivars were used to determine economic optimum fertilisation levels for different maize cultivars at different locations. The conditions for such determinations are that the reaction of at least one cultivar on fertiliser must be known, and that the relationships between yields of different cultivars must be available. The variances between observed and predicted cultivar yields are relatively small. The proposed method should thus be satisfactory for the prediction of yields.

INTRODUCTION

Individual maize cultivars react differently to fertilisation at a given level of management and differential fertilisation levels can thus potentially have a large influence on the profitability of maize cultivation and also on optimal cultivar selection.

The optimum level of application of an input is that level where marginal revenue equals marginal cost. Because different cultivars react differently in the same environment, and so also the same cultivar in different environments, it can be expected that the economic optimum level of fertilisation will vary between cultivars at the same location. Within cultivar trials fertilisation applications are usually kept constant for all the cultivars at any specific location. Fertilisation trials of amongst others, the Fertiliser Society, are also not cultivardirected. The effect of fertilisation on a cultivar is therefore not directly determinable.

The problem can possibly be overcome by using adaptation regression lines of cultivars. The condition is that the reaction of at least one cultivar on fertilisation must be known. Adaptation regression lines, using those cultivars with known reaction on fertilisation as standards, can then be used to determine optimum fertilisation levels for all the cultivars. Although this method cannot have the same degree of accuracy as cultivar directed fertilisation trials, it can yet potentially give an indication of the differential reaction on fertilisation by different cultivars. The most important disadvantage of the method is that it implicitly assumes that the fertilisation component can be isolated from other environmental factors; the interaction between all the components distributed over the environment might thus be neglected. If it is, however, considered that fertiliser trials on all cultivars would be impractical and very expensive, this procedure has a potential application value.

The regression line evaluation technique was developed to enable objective cultivar evaluation in less stable South African production areas.

In the early stage of development of a crop, differences between cultivars can be considerable, and cultivar means for environments can in such conditions yield useful and stable evaluation criteria. However, as differences between cultivars become smaller, usually as a result of breeding, genotype-environment interaction tends to become increasingly important relative to pure cultivar differences (Geerthsen, undated). The value and potential result of cultivar means as evaluation criteria therefore decline.

If the genotype-environment interaction effects are relatively stable over years, the cultivation area can be divided into homogeneous regions in which these interactions are a minimum (Geerthsen, 1974:191).

However, Robbertse (1969) shows that stable genotype-environment interactions over years do not occur in maize yields in the R.S.A. The interaction can therefore not satisfactorily be reduced by area classification.

Robbertse (1973a:64) consequently identified factors that describe a geographical locality and which may possibly influence maize cultivar yields. In all cases, mean trial yields showed the highest correlation with a specific cultivar yield, while correlations between locality characteristics and cultivar yield were smaller (Robbertse, 1970). It was furthermore found that the mean trial yield explains 89 per cent of variation in cultivar yield and also that the relationship between the two variables is almost invariably linear. These linear regression

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graphs change relatively little over time. This points to a high degree of reliability with the method.

Two computer programs, developed by the Department of Genetics at the University of Pretoria in PL/1, execute the regression line graph technique physically. The first program calculates the regression formula and related statistics, while the second program controls the graph plotter and plots the regression line with confidence curves at a 5 per cent level of significance.

CALCULATION OF OPTIMUM FERTILISATION LEVELS

The Department of Plant Production at the University of Pretoria has been conducting fertiliser trials with nitrogen (N), phosphorus (P) and potassium (K) under various levels of moisture stress on the maize cultivar R200 since 1967. The experimental design, soil characteristics and methods of experimentation have been described by Verwey (1974).

These fertiliser trials on cultivar R200 were used to determine the reaction of this cultivar on fertiliser and more specifically, to N,P and K. A production function was fitted on the fertiliser trial results to determine the relationship between yield and applications of N,P and K. Previous research also points to possible interactions between N,P and K. The functional relationship, symbolically, is as follows:

$Y = f(N,P,K)$

where Y = maize yield (kg/ha)
N = nitrogen application (kg/ha)
P = phosphorus application (kg/ha)
K = potassium application (kg/ha)

Choice of statistical models

According to Groenewald (1967:153), linear, Spillman, quadratic and square-root functions in particular are used for this type of statistical production function. These functions were fully described by Heady and Dillon (1961), while Groenewald (1967) gave a review of literature concerning the evaluation and application possibilities.

The fertilisation trials of the University of Pretoria have been conducted over a range of fertilisation and moisture levels, also involving situations with low moisture status and high fertiliser levels. Negative marginal yields with increasing fertiliser application can therefore also be expected. Only functions that provide for this were considered in this analysis and thus linear, Cobb-Douglas and Spillman functions were not considered. According to Groenewald (1967) and also Heady and Dillon (1961), quadratic and square-root functions often produce the best fits. According to Coldwell (1974:938) both quadratic and square-root functions are convenient to use in the determination of the effect of N,P and K on yield. The square-root function is, however, preferable to the quadratic function because it yields a more realistic response curve with a gradual or moderate curvature in the vicinity of maximum yield. Nieuwoudt and Behrman (1976:15), however, used the quadratic function to determine the economic optimum level of fertiliser application because of its desirable characteristics such as greater flexibility.

In this analysis, both square root and quadratic functions were fitted on available data. Data from 1967 to 1983 were provided by the Department Plant Production of the University of Pretoria. The STEPWISE-procedure of SAS was used for forward and backward selections (Ray,1982:101). Some selected fits are shown in Table 1 with their results in Table 2.

Table 2 shows that all the models are highly significant. The relatively high R^2 values also show that N,P and K (independent variables) explain a large percentage of the variation in yield (the dependent variable). The interaction between potassium (K) and phosphorus (P) is not significant in any of the models. The interaction between nitrogen (N) and potassium (K) is significant in Models 1 and 2. All the other variables in the models are highly significant.

Because of the higher R^2 values obtained with the square root functions, as well as the moderate curvature in the reaction curve in the vicinity of maximum yield, it was decided to use Model 4 to calculate the reaction of R200 on N,P and K. The independent variables are all highly significant. The fertilisation needs of cultivar R200 have thus been characterised.

TABLE 1 - Variables associated with each regression coefficient in the maize yield models

Regression coefficient	Variable associated with regression coefficient			
	Model 1	Model 2	Model 3	Model 4
b_0	Intercept	Intercept	Intercept	Intercept
b_1	N	N	N	N
b_2	P	P	P	P
b_3	K	K	K	K
b_4	N^2	N^2	$\sqrt{N}$	$\sqrt{N}$
b_5	K^2	K^2	$\sqrt{K}$	$\sqrt{K}$
b_6	P^2	P^2	$\sqrt{P}$	$\sqrt{P}$
b_7	NP	NP	$\sqrt{NP}$	$\sqrt{NP}$
b_8	PK		$\sqrt{PK}$	
b_9	NK	NK	$\sqrt{NK}$	$\sqrt{NK}$

TABLE 2 - Empirical results of a few selected maize yield models for R200

Coefficient	Model 1		Model 2		Model 3		Model 4	
	Value	Significance	Value	Significance	Value	Significance	Value	Significance
F-value (regression)	51,97	0,0001	58,65	0,0001	55,73	0,0001	62,87	0,0001
b_0	1 771,82		1 782,00		2 457,30		2 415,58	
b_1	11,67	0,0001	11,64	0,0001	-9,79	0,0009	-9,46	0,0006
b_2	37,66	0,0001	37,76	0,0001	-25,38	0,0005	-24,39	0,0002
b_3	23,72	0,0001	23,72	0,0001	-26,86	0,0001	-26,85	0,0001
b_4	-0,025	0,0005	-0,025	0,0001	172,60	0,0001	173,62	0,0001
b_5	-0,141	0,0001	-0,141	0,0001	252,91	0,0001	252,40	0,0001
b_6	-0,199	0,0001	-0,202	0,0001	378,39	0,001	376,68	0,0001
b_7	0,105	0,0087	0,105	0,0086	17,11	0,0013	17,21	0,0012
b_8	-0,002	0,9187			1,13	0,7591		
b_9	0,039	0,0462	0,039	0,459	14,73	0,0002	13,80	0,0002
R^2	0,8014		0,8014		0,8180		0,8179	
D.F. : Model	9		8		9		8	
: Error	629		630		629		630	
: Total	638		638		638		638	

Calculation of the economic optimum fertilisation levels of N,P and K for different cultivars

Based on the reaction of cultivar R200 on N,P and K, the reaction of other cultivars were determined by using regression analysis of their yield against that of R200.

The complexity and interdependence of environmental components in the growing of maize render it infeasible to include all the components as variables in an empirical analysis. Therefore all other factors, except locality, fertilisation and managerial level, were regarded as given for all cultivars. Thus cultivation and tilling practices differ between localities, but are assumed to be constant for all the maize cultivars at a specific locality.

Maize cultivar trial results of the Summer Grain Centre of the Department of Agriculture were used as basis for the regression analysis. In order to be usable, trial results must be available for a number of years for a specific cultivar in a specific locality. The minimum number of observations needed is determined by environmental characteristics such as rainfall and temperature cycles, as well as the desired level of statistical reliability. Another factor that warrants consideration is that yield results of the new improved cultivars are available only for a limited period.

Reliable maize cultivar trial results were obtained for 14 years from the Summer Grain Centre where cultivation practices remained relatively constant for a specific locality. Maize cultivar trial localities have changed considerably over time. Only in exceptional cases have trials been executed for more than 10 years at the same locality.

With these factors in mind, nine maize cultivars and four localities could be used. Observations extending over 14 years were obtained for each of the cultivars at every locality. The cultivars are SA 4, SA 5, SSM 48, PNR 88, NPPxK64R, A471W, PNR95, SR 52 and R200, and the localities are the experimental farms of the Department of Agriculture at Potchefstroom, Bethlehem and Cedara as well as the experimental farm of the Eastern Transvaal Co-operative (OTK) at Bethal.

The four chosen localities vary considerably in regard to geographic location, climate and soil characteristics; it may therefore be concluded that yield potential will also vary among localitites. The recommended optimum cultivation practices were followed for each locality (Coetzee, 1984).

The selected cultivars vary with regard to growth period, disease resistance and adapted areas (Dÿkhuys, 1973). All the adaptation regression line graphs that are typical of the various adaptation forms (Du Toit and Geerthsen, 1970:80; Robertse, 1973 b:59), are represented by one or more of the selected cultivars.

Maize cultivar trial yields at the four centres are shown in Table 3.

Regression equations showing the relationship between yields of cultivar R200 and the other cultivars over environments were calculated with the GLM-procedure of SAS (Ray,1982) and are shown in Table 4.

All the regression equations in Table 4 are highly significant. The R^2 values are consistently relatively high, and the regressions may thus be used for estimation purposes.

Factors other than fertilisation, however, also play a role in determining environment. Adjustments must be made for these in order to calculate optimum fertilisation levels for different cultivars at different localities. The adjustment factor can be calculated for each locality by comparing the reaction of R200 on N,P and K, as calculated with Model 4, with yields of R200 in fertilisation and cultivar trials at each locality at the given application levels of N,P and K.

Optimum applications of N,P and K were

determined by equating the partial derivative of each element in Model 4 with the corresponding nutrient/maize price ratio. The three equations were solved simultaneously. Maize and fertiliser prices for the 1982/83 production season were used for this purpose. The results are shown in Table 5.

An indication of the extent to which the different production functions of the different cultivars correctly predict the reaction of that cultivar on N,P and K at each locality, can be obtained by substituting the applied fertilisation in cultivar trials in the production functions and comparing the resulting yields with actual cultivar-trial yields. Table 6 shows the percentage differences between observed yields and yields as determined by the production functions. This

TABLE 3 - Maize cultivar yields at four trial localities

Locality	Year	Maize cultivar trial yield (kg/ha)									Mean (kg/ha)
		SA4	SA5	SSM 48	PNR 88	NPPx K64R	A471W	PNR 95	SR 52	R200	
BETHAL	1	7 940	9 624	8 673	8 634	7 418	7 959	8 925	10 812	7 121	8 567
	2	8 546	10 095	8 740	8 023	8 079	7 040	7 997	9 480	6 919	9 324
	3	7 648	7 124	6 706	7 917	6 723	6 715	8 212	10 513	8 633	7 799
	4	6 379	6 624	7 162	6 998	7 085	6 261	7 492	8 442	7 916	7 151
	5	2 940	1 938	2 023	2 337	1 945	2 590	3 031	1 084	1 897	2 198
	6	3 138	2 798	2 191	1 804	1 321	3 817	3 163	491	1 985	2 300
	7	6 561	6 936	7 755	7 152	5 318	6 719	7 765	8 649	7 104	7 106
	8	7 166	6 875	7 539	6 885	6 794	7 007	7 715	8 224	7 059	7 251
	9	5 959	7 145	6 224	4 502	7 596	6 163	8 713	5 245	6 835	6 609
	10	6 734	7 511	6 442	6 732	8 989	6 006	6 843	5 450	7 102	6 867
	11	2 005	2 324	1 455	2 213	2 137	2 181	2 716	2 640	2 807	2 275
	12	5 466	1 620	3 851	4 553	3 190	3 256	3 919	3 940	4 732	3 836
	13	1 219	1 655	1 904	1 818	2 057	1 586	1 604	1 774	1 513	1 681
	14	1 513	973	1 461	1 219	1 042	1 662	1 475	1 400	1 396	1 349
POTCHEFSTROOM	1	5 818	6 593	5 563	5 542	5 469	6 837	6 743	5 711	6 536	6 090
	2	3 873	3 580	3 649	4 381	3 509	5 386	4 105	3 139	4 363	3 998
	3	6 507	6 532	6 069	5 486	5 507	7 390	6 599	5 719	6 387	6 244
	4	5 549	6 044	5 881	5 425	5 162	7 081	6 281	5 977	6 078	5 942
	5	2 901	2 831	2 974	2 669	2 255	3 381	2 411	1 074	3 263	2 639
	6	3 159	2 841	3 138	2 641	2 326	3 689	2 633	1 832	3 544	2 867
	7	4 446	4 362	3 710	4 791	4 216	5 706	5 121	4 462	5 071	4 653
	8	3 979	4 206	4 184	4 121	3 914	5 836	4 466	4 203	5 179	4 454
	9	3 226	3 383	3 027	3 622	3 022	4 699	4 217	2 736	4 096	3 558
	10	2 917	2 650	3 280	3 653	3 504	4 969	3 932	2 615	4 036	3 506
	11	2 244	2 192	1 872	2 328	1 896	2 818	1 938	772	2 838	2 099
	12	1 789	2 002	2 157	1 989	1 742	2 590	2 563	710	2 747	2 032
	13	3 703	3 937	3 677	3 536	3 157	3 171	2 203	1 581	2 968	3 103
	14	2 295	2 708	2 055	2 407	2 151	2 349	1 837	1 068	2 286	2 128
BETHLEHEM	1	4 329	5 019	5 191	5 235	5 068	6 468	6 616	6 335	4 763	5 447
	2	4 004	4 357	4 139	5 083	4 042	5 994	5 013	4 455	3 997	4 570
	3	4 546	4 524	4 376	4 260	4 557	4 126	4 941	5 197	3 164	4 410
	4	4 350	3 925	4 597	4 340	3 869	3 270	4 331	4 629	2 885	4 021
	5	3 684	3 675	4 176	3 502	2 988	3 726	3 452	2 330	3 646	3 464
	6	3 170	3 446	3 877	2 991	2 206	3 080	2 974	2 514	3 212	3 052
	7	4 761	4 671	5 209	4 915	4 184	4 682	5 728	5 110	4 114	4 819
	8	5 012	4 324	4 866	4 790	4 653	5 024	4 764	4 371	4 481	4 698
	9	7 404	6 290	6 755	7 892	7 080	8 534	8 072	9 379	8 990	7 828
	10	6 416	6 819	7 259	6 361	6 498	7 821	7 626	8 787	8 422	7 334
	11	2 420	2 249	2 284	2 080	1 900	2 451	1 967	63	1 627	1 893
	12	2 110	2 609	2 471	1 981	1 911	2 469	1 847	63	1 632	1 899
	13	2 962	2 702	3 231	2 790	2 833	3 034	2 969	503	2 348	2 596
	14	2 485	2 740	2 594	2 636	2 312	2 815	2 435	442	2 113	2 285
CEDARA	1	6 988	6 929	7 918	8 562	9 352	8 040	9 003	11 608	8 806	8 578
	2	7 371	7 447	8 525	8 505	8 130	8 446	8 752	10 906	8 765	8 538
	3	5 564	5 020	6 621	6 418	8 463	7 338	7 435	11 754	7 862	7 386
	4	4 741	4 381	7 019	7 338	6 574	6 260	7 874	10 389	7 320	6 877
	5	6 056	4 995	6 768	5 669	6 186	5 678	7 991	9 814	7 635	6 754
	6	6 946	5 192	7 413	6 107	6 795	7 243	7 345	9 218	8 080	7 148
	7	5 157	4 229	5 174	5 952	5 611	6 201	6 315	7 357	6 899	5 877
	8	4 584	5 004	4 734	5 578	5 122	5 307	6 280	5 907	6 034	5 394
	9	4 457	4 034	5 081	4 894	4 836	4 089	5 309	5 454	4 789	4 771
	10	4 980	4 215	5 078	5 165	5 123	4 385	5 689	5 919	5 090	5 071
	11	6 171	4 294	5 190	5 307	4 839	5 335	6 762	7 902	5 851	5 739
	12	4 401	4 244	5 809	6 131	4 948	5 455	7 762	8 080	5 983	5 869
	13	2 985	3 077	3 583	3 675	3 874	3 895	3 435	1 012	4 669	3 356
	14	3 140	2 906	3 049	3 251	2 757	3 117	3 006	876	3 917	2 891

Source: Summer Grain Centre (1984)

method of comparison has a limitation in that only means at a certain fertilisation level can be compared.

must be available.

The differences between observed and predicted cultivar yields can probably mainly be ascribed thereto that the calculated production functions do not sufficiently consider the interactions between fertilisation, cultivar and the other environmental factors. The magnitude of the differences is however relatively small. The production functions can thus indeed be used satisfactorily for the prediction of yields.

TABLE 4 - The relationship between the yield of R200 and the other maize cultivars in the model

Cultivar	Regression equation (Y = a + bX)*	Degrees of freedom					
		Model	Error	Total	R^2 Value	F Value	P Value
SA4	Y = 879,84 + 0,743X	1	54	55	0,8086	228,19	0,0001
SA5	Y = 810,46 + 0,734X	1	54	55	0,8505	306,95	0,0001
SSM48	Y = 607,20 + 0,831X	1	54	55	0,8354	273,99	0,0001
PNR88	Y = 564,48 + 0,838X	1	54	55	0,8759	381,01	0,0001
NPPxK64R	Y = 70,20 + 0,896X	1	54	55	0,8524	311,92	0,0001
A471W	Y = 1033,98 + 0,792X	1	54	55	0,8494	304,67	0,0001
PNR95	Y = 313,00 + 0,976X	1	54	55	0,8753	379,19	0,0001
SR52	Y = -2187,27 + 1,440X	1	54	55	0,8383	280,01	0,0001
R200	Y = 0,00 + 1,000X	1	54	55	1,000	999,99	0,0000

* Y = yield of cultivar in kg/ha
X = yield of R200 in kg/ha

TABLE 6 - Percentage differences between observed and calculated cultivar yields at different localities (%)

Cultivar	Locality			
	Bethal	Potchefstroom	Bethlehem	Cedara
SA 4	5,02	2,62*	5,18	4,69*
SA 5	6,41	0,20	6,40	9,57*
SSM 48	1,82	5,08	7,36	1,45*
PNP 88	2,01	3,45	5,51	1,13
NPPxK64R	2,49	5,59	5,00	0,03*
A471W	2,43*	5,05*	5,62	3,63*
PNR95	2,59*	6,60*	5,12	0,23*
SR52	2,40*	13,02*	7,76	2,69
R200	4,28	1,49	3,18	1,71

*The production function overestimates yields, in all other cases it underestimates yields

The differences in Table 6 can be caused thereby that the means were compared at only one level of fertilisation and that, as a result of having too few observations the observed trial yield may not be a reliable reflection of the reaction of the cultivars to fertilisation. The reason for the differences, however, more probably lies in the fact that the production functions do not sufficiently take into account the interactions between fertilisation and the other environmental factors and thus erroreously predict the reaction of the cultivars on N,P and K fertilisation. However, from Table 6 it appears that, with the exception of SR52 at Potchefstroom, all the differences are smaller than 10 per cent. This exception with SR52 can possibly be explained by SR52's exceptional sensitivity to humidity. It would thus appear that the production functions can be used satisfactorily to predict yields.

CONCLUSION

Empirical results indicate that adaptation regression lines of cultivars can possibly be used to determine economic optimum fertilisation levels for different maize cultivars at different localities. The conditions are that the reaction of at least one cultivar on fertilisation must be known, and that relationships between yields of different cultivars must be available.

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TABLE 5 - Production functions and optimum application levels of N, P and K of the cultivars in the model at Bethal, Potchefstroom, Bethlehem and Cedara

Locality	Cultivar	Values of coefficients									Optimum quantities (kg/ha)		
		b_0	b_1	b_2	b_3	b_4	b_5	b_6	b_7	b_9	N	P	K
BETHAL	SA4	2 510,9	- 6,4	- 18,5	- 20,1	117,2	254,3	170,4	11,6	9,3	62	40	49
	SA5	2 421,3	- 6,3	- 18,3	- 19,9	115,7	251,1	168,3	11,5	9,2	61	40	49
	SSM48	2 433,1	- 6,9	- 20,7	- 22,5	131,2	284,6	190,7	13,0	10,4	74	44	53
	PNR88	2 405,1	- 7,2	- 20,9	- 22,7	132,2	286,9	192,2	13,1	10,5	71	44	53
	NPPxK64R	2 036,7	- 7,7	- 22,3	- 24,2	141,3	306,5	205,4	14,0	11,2	75	46	55
	A471W	2 772,3	- 6,8	- 19,7	- 21,4	124,9	271,0	181,6	12,4	10,0	67	42	51
	PNR95	2 456,3	- 8,4	- 24,3	- 26,4	154,0	334,1	223,9	15,3	12,2	86	48	59
	SR52	974,9	- 12,4	- 35,9	- 39,0	227,2	492,9	330,3	22,5	18,1	117	60	71
	R200	2 196,0	- 8,6	- 24,9	- 27,1	157,8	342,3	229,4	15,6	12,5	85	49	59
POTCHEFSTROOM	SA4	2 087,5	- 4,7	- 13,7	- 14,9	86,8	188,2	126,1	8,6	6,9	44	31	40
	SA5	2 003,2	- 4,7	- 13,5	- 14,7	85,7	185,9	124,6	8,5	6,8	43	31	39
	SSM48	1 959,1	- 5,3	- 15,3	- 16,7	97,1	210,7	141,2	9,6	7,7	50	34	43
	PNR88	1 927,3	- 5,4	- 15,5	- 16,8	97,9	212,4	142,3	9,7	7,8	50	35	43
	NPPxK64R	1 526,18	- 5,7	- 16,5	- 18,0	104,6	227,0	152,1	10,4	8,3	54	37	45
	A471W	2 321,0	- 5,1	- 14,6	- 15,9	92,5	200,6	134,4	9,2	7,4	49	34	41
	PNR95	1 899,9	- 6,2	- 18,0	- 19,6	114,0	247,4	165,7	11,3	9,1	62	40	48
	SR52	154,0	- 9,2	- 26,5	- 28,9	168,2	365,0	244,5	16,7	13,4	90	51	61
	R200	1 625,9	- 6,4	- 18,4	- 20,0	116,8	253,4	169,8	11,6	9,3	62	40	49
BETHLEHEM	SA4	2 006,3	4,4	12,8	13,9	80,9	175,6	117,7	8,0	6,4	40	29	38
	SA5	1 923,0	4,4	12,6	13,7	79,9	173,4	116,2	7,9	6,4	39	29	37
	SSM48	1 868,3	5,0	14,3	15,6	90,6	196,6	131,7	9,0	7,2	46	32	41
	PNR88	1 835,7	5,0	14,4	15,7	91,3	198,2	132,8	9,0	7,3	46	33	41
	NPPxK64R	1 428,4	5,3	15,4	16,7	97,6	211,7	141,9	9,7	7,8	50	34	43
	A 471W	2 234,6	4,7	13,6	14,8	86,2	187,1	125,4	8,5	6,9	45	31	40
	PNR95	1 793,3	5,8	16,8	18,3	106,3	230,7	154,6	10,5	8,5	57	37	47
	SR52	3,0	8,6	24,8	26,9	156,9	340,4	228,1	15,5	12,5	85	49	59
	R200	1 516,7	6,0	17,2	18,7	109,0	236,4	158,4	10,8	8,7	57	38	47
CEDARA	SA4	2 597,4	6,8	19,5	21,2	123,4	267,7	179,4	12,2	9,8	66	42	51
	SA5	2 506,8	6,7	19,2	20,9	121,9	264,4	177,2	12,1	9,8	66	41	51
	SSM48	2 529,9	7,6	21,8	23,7	138,1	299,7	200,8	13,7	11,0	74	45	54
	PNR88	2 502,8	7,6	22,0	23,9	139,2	302,1	202,4	13,8	11,1	76	45	55
	NPPxK64R	2 141,0	8,1	23,5	25,5	148,8	322,8	216,3	14,7	11,8	80	47	57
	A471W	2 864,5	7,2	20,8	22,6	131,2	285,3	191,2	13,0	10,5	72	43	52
	PNR95	2 569,9	8,9	25,6	27,8	162,2	351,8	235,7	16,1	12,9	89	51	61
	SR52	1 142,7	13,1	37,8	41,1	239,2	519,1	347,8	23,7	19,0	121	62	73
	R200	2 312,4	9,1	26,2	28,5	166,1	360,5	241,5	16,5	13,2	89	51	61

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