The impact of lime on maize and soybean in conservation farming basins

Introduction

The purpose of the trial is to find the impact of lime on maize and soybean yields in conservation farming basins in the region IIa agro-ecological zone. The maize and soybean are under a two-year rotation, but this is the first year of the trial, so no time effect can be measured.

Data

The mean soybean yield was 1,665kg ha^{-1} with a standard deviation of 621kg. The median is 1,691kg ha^{-1}, which suggests the distribution is close to normal. The minimum was 727kg and the maximum 3,192kg.

The mean maize yield was 5,035kg ha^{-1} with a standard deviation of 1,604kg. The median is 4,835kg, the minimum was 1,517kg and the maximum 8,595kg.

Clusa maize/soyabean trial						
	n	**Mean**	**Median**	**StDev**	**Minimum**	**Maximum**
Soyabean	42	1,665kg	1,691kg	621kg	727kg	3,192kg
Maize	53	5,035kg	4,835kg	1,604kg	1,517kg	8,595kg

Soybean

Table 1 shows the distribution of soybean yields with and without lime. The mean yield without lime is 1,554kg ha^{-1} with a standard deviation of 588.5kg, and with lime 1,776kg with a standard deviation of 646kg. There is no significant difference between the yields.

Table 1 shows the distribution of soybean yields with and without lime.

```
ANALYSIS OF VARIANCE ON Yield
SOURCE     DF         SS         MS         F         p
Lime        1     515858     515858      1.35     0.252
ERROR      40   15278415     381960
TOTAL      41   15794273

                                    INDIVIDUAL 95% CI'S FOR MEAN
                                    BASED ON POOLED STDEV
 LEVEL      N       MEAN      STDEV  ---------+---------+---------+-------
    -1     21     1554.4      588.5  (----------*----------)
     1     21     1776.1      646.2            (----------*----------)
                                    ---------+---------+---------+-------
POOLED STDEV =     618.0                   1500      1750      2000
```

Table 2 shows the distribution of soybean yields by region. The yield from 39 treatments in Western region is 1,575kg ha^{-1} with a standard deviation of 531kg, and from three treatments in Central region 2,844kg ha^{-1} with a standard deviation of 548kg ha^{-1}. The mean yields are significantly different in the two regions.

Table 2 shows the distribution of soybean yields by region.

```
ANALYSIS OF VARIANCE ON Yield
SOURCE     DF         SS         MS         F         p
Region      1    4489037    4489037     15.88     0.000
ERROR      40   11305236     282631
TOTAL      41   15794273

                                    INDIVIDUAL 95% CI'S FOR MEAN
                                    BASED ON POOLED STDEV
 LEVEL      N       MEAN      STDEV  -------+---------+---------+---------
     0     39     1574.6      530.7  (--*--)
     2      3     2844.0      548.2               (---------*----------)
                                    -------+---------+---------+---------
POOLED STDEV =     531.6               1800      2400      3000
```

Maize

Table 3 shows the distributions of maize yields with and without lime. The yield of maize per hectare without lime is 5,020kg with a standard deviation of 1,500kg, and with lime is 5,050kg with a standard deviation of 1,725kg. The difference in yield is not significant.

Table 3 shows the distributions of maize yields with and without lime.

```
ANALYSIS OF VARIANCE ON Yield
SOURCE     DF         SS         MS         F         p
Lime        1      12410      12410      0.00     0.945
ERROR      51  133690672    2621386
TOTAL      52  133703080

                                    INDIVIDUAL 95% CI'S FOR MEAN
                                    BASED ON POOLED STDEV
 LEVEL      N       MEAN      STDEV  -----+---------+---------+---------+-
Without    26       5020       1500  (------------------*------------------)
With       27       5050       1725   (------------------*-----------------)
                                    -----+---------+---------+---------+-
POOLED STDEV =     1619               4550      4900      5250      5600
```

Table 4 shows the distributions of maize yields between regions. In Western region the mean yield is 5,144kg ha^{-1} with a standard deviation of 1,500kg, and in Central region, 4,701kg ha^{-1} with a standard deviation of 1,916kg. There is no significant difference between the yields.

Table 4 shows the distributions of maize yields between regions.

```
ANALYSIS OF VARIANCE ON Yield
SOURCE     DF         SS         MS         F         p
Region      1    1921833    1921833      0.74     0.392
ERROR      51  131781248    2583946
TOTAL      52  133703080

                                    INDIVIDUAL 95% CI'S FOR MEAN
                                    BASED ON POOLED STDEV
 LEVEL      N       MEAN      STDEV  ----+---------+---------+---------+--
Western    40       5144       1500                   (---------*---------)
Central    13       4701       1916  (-----------------*-----------------)
                                    ----+---------+---------+---------+--
POOLED STDEV =     1607               4000      4500      5000      5500
```

Results

Table 5 shows the results from an analysis of soybean yields using the general linear model. The sitemean is strongly significant as expected. Lime has a significant impact on yield, demonstrated

by the F-statistic of 40.81 and one and 36 degrees of freedom after omitting studentised residuals outside ±2 standard deviations. The results suggest that lime increases soybean yields by an average of 18.34 per cent from the adjusted mean of 1,478kg ha^{-1} to the adjusted mean of 1,749kg ha^{-1}.

Table 5 shows the results from an analysis of soybean yields using the general linear model.

```
F-test with denominator: Error
Denominator MS =  17782 with  36 degrees of freedom

Numerator       DF    Seq MS      F       P
Sitemean         1 11724850 659.38   0.000
Lime             1   725748  40.81   0.000
Lime*Sitemean    1   296404  16.67   0.000
```

There is also an interaction between lime and the site mean, implying that there is a yield advantage through better farm management. Figure 1 shows the soybean yields with and without lime. The green line is without lime and the red line is with lime. The black line the yield after deducting the cost of the lime. The divergence is clear. The cost of the lime is K50,000 per hectare and the value of soybean is K900 per kilogram, so the cost of the lime in terms of yield is 55.56 kilograms.

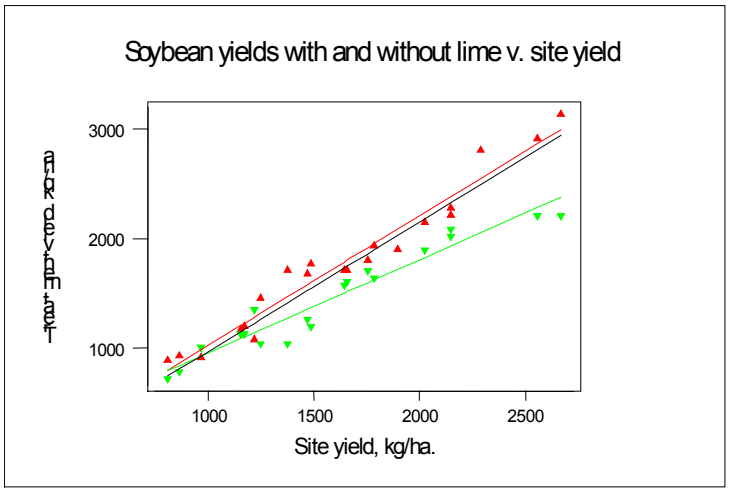

Figure 1 shows the soybean yields with and without lime. The green line is without lime and the red line is with lime. The black line the yield after deducting the cost of the lime.

Table 6 shows the results from the analysis of maize yields using the general linear model. The sitemean is significant as expected. Lime is significant after outliers defined by studentised residuals beyond plus and minus two standard deviations are removed, and so is the lime and sitemean, which implies that there is some yield to be gained through experience. Figure 2 shows the significant divergence of maize yields with and without lime. The results suggest that lime increases maize yields by an average of eight per cent, from an adjusted mean of 4,880kg ha^{-1} to an adjusted mean of 5,269kg ha^{-1}, and that there is some increasing yields to farm management.

Table 6 shows the results from the analysis of maize yields using the general linear model.

```
F-test with denominator: Error
Denominator MS =  180638 with  45 degrees of freedom

Numerator        DF    Seq MS       F        P
Sitemean          1 99104976 548.64    0.000
Lime              1  1848081  10.23    0.003
Lime*Sitemean     1   559496   3.10    0.085
```

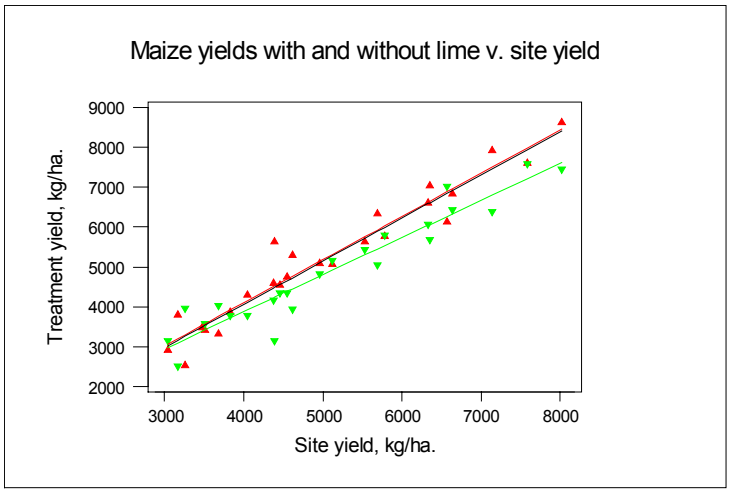

Figure 2 shows the significant divergence of maize yields with and without lime.

Conclusions

1) The average increase in yield from applying lime to soybean is 18.34 per cent, and has increasing yields to farm management. The cost of lime is covered from about 1,000kg ha^{-1}.

2) The average yield increase from applying lime to maize is eight per cent, and there are some increasing yields to farm management. The cost of lime is covered from about 3,000kg ha^{-1}.