The performance of groundnuts with lime and conservation farming systems

Introduction

The first purpose of the study is to investigate the yield performance of groundnuts with and without lime by conservation farming method and conventional farming practice, in region III agro-ecological zone. The second is to establish the yield performance of groundnuts under conservation farming basins, conventional farming practice and conservation farming permanent ridges in region III agro-ecological zone. The trials are in region III agro-ecological zone, in Northern and Copperbelt regions.

Data

Table 1 shows the distribution of groundnut yields in region III. From 146 treatments of groundnuts, the mean yield was 841kg ha^{-1} with a standard deviation of 294kg. The median was 790kg, which suggests a few farmers had higher yields than expected. The minimum yield was 421kg and the maximum 1,492kg.

Table 1 shows the distribution of groundnut yields in region III.

	Demonstation plots					
	n	**Mean**	**Median**	**StDev**	**Minimum**	**Maximum**
Yield	146	841kg	790kg	294kg	421kg	1,492kg

Table 2 shows the distributions of the yields from the different farming systems. The groundnut yield from 52 treatments using conservation farming basins was 876kg ha^{-1} with a standard deviation of 275kg; the yield from 48 treatments using conventional farming practice was 714kg ha^{-1}; and the yield from 46 treatments using conservation farming permanent ridges was 934kg ha^{-1} with a standard deviation of 319kg. The null hypothesis that the means are from the same sampling distribution fails to be accepted with an F-statistic of 7.83. The yields from conventional farming practice appear to be 23.5 per cent lower than using permanent ridges.

Table 2 shows the distributions of the yields from the different farming systems.

```
ANALYSIS OF VARIANCE ON Yield
SOURCE     DF        SS        MS        F        p
C104        2   1235537    617768     7.83    0.001
ERROR     143  11284359     78912
TOTAL     145  12519896
                                  INDIVIDUAL 95% CI'S FOR MEAN
                                  BASED ON POOLED STDEV
 LEVEL      N      MEAN     STDEV  --------+---------+---------+--------
CFBasins   52     876.3     274.6                (-----*-----)
Convent    48     713.7     246.3   (-----*------)
PermRidges 46     933.5     319.3                      (------*------)
                                  --------+---------+---------+--------
POOLED STDEV =    280.9               720       840       960
```

Table 3 shows the distributions of yields with and without lime. The yield of groundnuts without lime from 48 treatments is 714kg ha^{-1} with a standard deviation of 246kg; the yield with lime from 98 treatments however is 903kg ha^{-1} with a standard deviation of 296kg. The means fail to accept the null hypothesis and do not come from the same population with an F-statistic of 14.64. The yields without lime are 21 per cent lower than those with lime.

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

```
ANALYSIS OF VARIANCE ON Yield
SOURCE     DF         SS         MS         F         p
Lime        1    1155568    1155568     14.64     0.000
ERROR     144   11364328      78919
TOTAL     145   12519896

                                      INDIVIDUAL 95% CI'S FOR MEAN
                                      BASED ON POOLED STDEV
 LEVEL      N       MEAN      STDEV  -------+---------+---------+---------
    -1     48      713.7      246.3  (-------*-------)
     1     98      903.1      296.2                          (----*-----)
                                      -------+---------+---------+---------
POOLED STDEV =     280.9                 700       800       900
```

Table 4 shows the distributions of groundnut yields associated with Northern and Copperbelt regions. The Northern region has a mean groundnut yield from 66 treatments of 919kg ha^{-1} with a standard deviation of 306kg. This compares with 80 treatments from Copperbelt having a 15.5 per cent lower average yield of 776kg ha^{-1} with a standard deviation of 268kg. The means are not from the same population and fail to accept the null hypothesis with an F-statistic of 8.99.

Table 4 shows the distributions of groundnut yields associated with Northern and Copperbelt regions.

```
ANALYSIS OF VARIANCE ON Yield
SOURCE     DF         SS         MS         F         p
Region      1     735521     735521      8.99     0.003
ERROR     144   11784375      81836
TOTAL     145   12519896

                                      INDIVIDUAL 95% CI'S FOR MEAN
                                      BASED ON POOLED STDEV
 LEVEL      N       MEAN      STDEV  -+---------+---------+---------+-----
     0     66      919.0      306.1                    (--------*--------)
     1     80      776.4      268.4  (-------*-------)
                                      -+---------+---------+---------+-----
POOLED STDEV =     286.1            720       800       880       960
```

Table 5 shows the distributions of the yields associated with trial age. There are 102 new treatments run by farmers with an average yield of 872kg ha^{-1} with a standard deviation of 302kg. This is 11.7 per cent lower than 44 treatments by last year's farmers, who had a mean yield of 770kg ha^{-1} with a standard deviation of 263 kg. The null hypothesis fails to be accepted at a ten per cent level with an F-statistic of 3.77 and so it appears that the new farmers had a higher yield than the more experienced farmers.

Table 5 shows the distributions of the yields associated with trial age.

```
ANALYSIS OF VARIANCE ON Yield
SOURCE     DF         SS         MS         F         p
TrialAge    1     319379     319379      3.77     0.054
ERROR     144   12200517      84726
TOTAL     145   12519896

                                      INDIVIDUAL 95% CI'S FOR MEAN
                                      BASED ON POOLED STDEV
 LEVEL      N      MEAN     STDEV  ---+---------+---------+---------+---
     0    102     871.6     302.4                      (--------*-------)
     1     44     769.7     262.7   (-----------*-----------)
                                    ---+---------+---------+---------+---
POOLED STDEV =    291.1              700       770       840       910
```

Results

Lime

Table 6 shows the results from a general linear model. The lime is highly signficant with an F-statistic of 47.32 and the lime/no lime treatment yields diverge significantly with increasing site yield, which is demonstrated by the F-statistic of 161.68 and suggests the groundnut yield due to lime rises with increased farm management ability.

Table 6 shows the results from a general linear model.

```
F-test with denominator: Error
Denominator MS =  24420 with 142 degrees of freedom

Numerator        DF   Seq MS      F       P
Lime              1  1155568  47.32   0.000
Sitemean(Lime)    2  3948335 161.68   0.000
```

Figure 1 shows the divergence of groundnut yields with lime, the red line, and without lime, the green line. The black line is the groundnut yield after deducting the cost of the lime in terms of yield. There is no important shift in the constant term of the two lines[1], but the difference in the slope is significant[2]. Table 7 shows the slopes of yields with and without lime. They suggest that groundnut yields with lime are generally 22.2 per cent higher than groundnut yields without lime at any yield.

Table 7 shows the slopes of yields with and without lime.

```
Term               Coeff     Stdev  t-value      P
Constant          -34.29     54.41    -0.63  0.530
Sitemean(Lime)
           -1     0.8866    0.1012     8.76  0.000
            1    1.10800   0.07055    15.71  0.000
```

[1] F=0.1174.

[2] F=3.1743, p=0.046

The adjusted mean yield of groundnuts without lime is 692.4kg ha^{-1} with a standard deviation of 22.69kg. The adjusted mean yield of groundnuts with lime is 916.2kg ha^{-1} with a standard deviation of 15.81kg. On average this is a 32.3 per cent increase in groundnut yield associated with the application of lime.

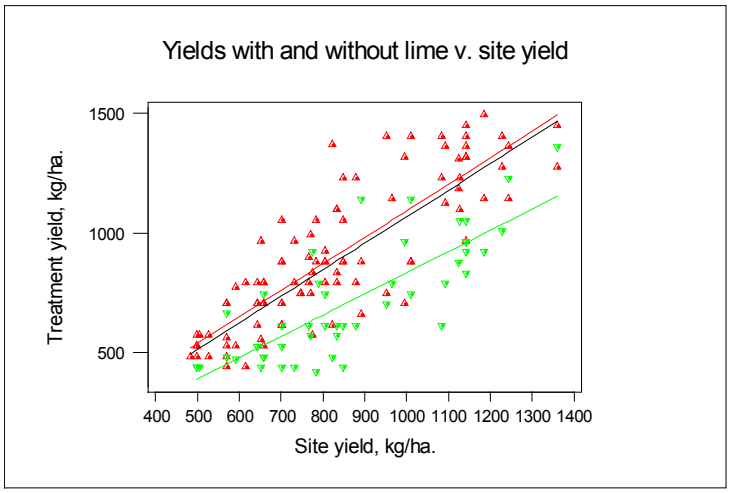

Figure 1 shows the divergence of groundnut yields with lime, the red line, and without lime, the green line. The black line is the groundnut yield after deducting the cost of the lime in terms of yield.

Farming systems

Table 8 shows the findings of the analysis of farming systems in region III agro-ecological zone. The systems are significantly different from each other and there is divergence among them with F-statistics of 27.12 and 118.48 respectively.

Table 8 shows the findings of the analysis of farming systems in region III agro-ecological zone.

```
F-test with denominator: Error
Denominator MS =  22776 with 140 degrees of freedom

Numerator           DF   Seq MS      F       P
Systems              2   617768  27.12   0.000
Sitemean(Systems)    3  2698575 118.48   0.000
```

Figure 2 shows the divergence of groundnut yields from the different farming systems. The green line is the yield line from conventional farming practice, the red line is from conservation farming basins and the blue line is from conservation farming permanent ridges. Table 9 shows the regression of yield against the covariate sitemean with the different systems in the general linear model. The constant terms are not significantly different for any of the lines[3]. The slope of conservation farming basins is not different from conventional farming practice but conservation permanent ridges are significantly different from conventional farming practice and conservation

[3] F-statistics are F=0.3491 (p=0.5655), F=0.0545 and F=0.7071, (p=0.3320) respectively.

farming basins[4]. These results suggest that there is no significant difference in groundnut yield between conservation farming basins and conventional farming practice, but conservation farming permanent ridges yields a significant 36.4 per cent more than conventional farming practice, and 23.3 per cent more than conservation farming basins.

Table 9 shows the regression of yield against the covariate sitemean with the different systems in the general linear model.

Term	Coeff	Stdev	t-value	P
Constant	-39.14	48.79	-0.80	0.424
Sitemean(Systems)				
-1	1.01739	0.09246	11.00	0.000
0	0.88661	0.09776	9.07	0.000
1	1.2503	0.1014	12.33	0.000

On average, the average yield of conservation farming basins is 873kg ha^{-1} with a standard deviation of 21.93kg, which is 26 per cent more than the 692kg ha^{-1} yield experienced from conventional farming practice. Conservation farming permanent ridges yield 979kg ha^{-1} with a standard deviation of 22.4kg. This is 41.5 per cent more than conventional farming practice and 12 per cent more than conservation farming basins.

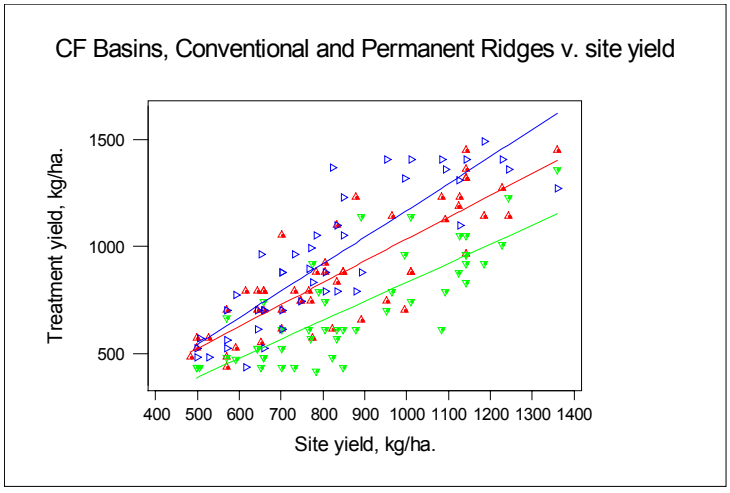

Figure 2 shows the divergence of groundnut yields from the different farming systems. The green line is the yield line from conventional farming practice, the red line is from conservation farming basins and the blue line is from conservation farming permanent ridges.

Conclusions

1) The use of lime on groundnuts increases yields by an average of 32.3 per cent overall, but is found to be an increasing function of yield, so that yields are generally 22.2 per cent higher than yields without lime, which means that improved yields from lime are a function of improved farmer management.

[4] F-statistics are F=0.9445 (p=0.2551), F=6.6695 (p=0.0058) and F=2.8818 (p=0.0558) respectively.

2) On average, conservation farming permanent ridges increases yields by 41.5 per cent over conventional farming practice and 12 per cent over conservation farming basins; however, conservation farming basins are not impacted by increased yields but yields from conservation farming permanent ridges are 36.4 per cent higher than conventional farming practice and 23.3 per cent more than conservation farming basins.

3) Since the use of conservation farming method is synonymous with using lime, and lime was not used on the conventional farming plot, it cannot be determined whether it is the conservation farming method or the lime that increases yields.

These findings apply to region III agro-ecological zones only.