

# STATISTICAL NOTES FOR AGRICULTURAL WORKERS.

## No. 8.—THE EFFECT OF DIFFERENT DOSES OF NITROGEN ON THE RATE OF SHEDDING OF BUDS, FLOWERS AND BOLIS IN THE COTTON PLANT IN SURAT.

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1. Mr. K. V. Joshi\* of the Cotton Research Laboratory, Surat, sent us the results (reproduced in Appendix I) of certain experiments on the cotton plant conducted by him in 1930-31. The object of the experiment was to study the effect of applying different doses of nitrogen. There were altogether 3 plots each consisting of 10 plants. One plot was left unmanured to serve as control. One plot was treated with 40 lbs. of nitrogen per acre, and the other plot with 100 lbs. of nitrogen per acre applied in the form of ammonium sulphate.

If we concentrate our attention on the mean yield we may use Fisher's method of analysis of variance for disentangling the different factors. A full discussion of the results is given below. The value of  $z$  is obtained in each case by dividing the variance to be tested by the residual variance and taking half the natural logarithms. That is

$$z = \frac{1}{2} \log_e \left( \frac{v}{v_0} \right)$$

where  $v_0$  is the residual variance. The critical values of (either on the basis of 5 per cent. or one per cent. probabilities) have been taken from Fisher's Table VI (Statistical Methods for Research Workers, 1930, 212-213).

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\* Full details of the experiments will be published by Mr. Joshi himself in due course. The present note is intended to offer a few suggestions regarding the statistical methods which would be found appropriate in such problems.

2. The analysis for the number of buds under different treatments is given in Tables I and II.

TABLE I.  
(Number of buds).

Comparisons	—	Sum of squares	Mean square	Value of <i>z</i>	
				Observed	5 per cent
Nitrogen vs. no nitrogen . . . . .	1	296,995.5	296,995.5	1.0856	0.720
Doses of nitrogen . . . . .	1	49,475.6	49,475.6	1.1882	0.720
Total . . . . .	2	346,471.1			
Residual . . . . .	26	876,740.7	33,875.0		
Total . . . . .	28	1,223,211.8			

TABLE II.  
(Number of buds).

Comparisons	No. of buds	Difference from	
		Control	40 lbs. nitrog
No manure . . . . .	434.3	—	—164.5
40 lbs. nitrogen . . . . .	599.8	+164.5	—
100 lbs. nitrogen . . . . .	701.0	+266.7	+102.2

Standard error of difference in means = 83.3.

The response due to the application of nitrogen is significant, but the differential response due to an increased dose of nitrogen is inappreciable.

3. The analysis for the number of flowers is given in Tables III and IV.

TABLE III.

(Number of flowers).

Comparisons	D. F.	Sum of squares	Mean variance	Value of z	
				Observed	Expected (5 per cent.)
Nitrogen vs. no nitrogen .	1	76,246.2	76,246.2	1.6388	0.7205
Different doses of nitrogen .	1	21,203.2	21,203.2	0.9989	0.7205
Treatment . . . . .	2	97,449.4	48,724.7		
Error . . . . .	26	76,374.5	2,875.9		
Total . . . . .	28	173,823.0			

TABLE IV.

(Number of flowers).

Comparisons	Mean number of flowers	Difference from	
		Control	40 lbs. nitrogen
No manure . . . . .	111.8	—	—76.2
40 lbs. nitrogen . . . . .	188.0	+76.2	—
100 lbs. nitrogen . . . . .	254.9	+143.1	+66.9

Standard error of difference in means = 23.01.

Both the doses of nitrogen have significantly increased the number of flowers per plant; the additional dose of nitrogen is also effective in further stimulating the formation of flowers from buds.

4. The analysis for bolls is given in Tables V and VI.

TABLE V.

(Number of bolls).

Comparisons	D. F.	Sum of squares	Mean variance	Value of z	
				Observed	5 per cent.
Nitrogen vs. no nitrogen. .	1	8,545	8,545	1.7130	0.7205
Different doses of nitrogen .	1	1,832	1,832	0.9428	0.7205
Treatment . . . . .	2	10,377	5,180.		
Error . . . . .	26	7,222	278		
Total .	28	17,599			

Standard error of difference in means = 7.46.

TABLE VI.

(Number of bolls).

Comparisons	Mean number of bolls	Difference from	
		Control	40 lbs. nitrogen
Control . . . . .	36.2	—	—26.8
40 lbs. nitrogen . . . . .	63.0	+26.8	—
100 lbs. nitrogen . . . . .	82.6	+46.4	+19.6

Standard error of the difference in means = 7.45.

The efficacy of nitrogen is definitely established. Moreover, the additional 60 lbs. of nitrogen too is found to increase the number of bolls quite appreciably.

5. We may now consider the effect of nitrogen on the rates of shedding.

The analysis of the percentage success of buds developing into flowers is given in Tables VII and VIII.

TABLE VII.

(Flowers : Buds).

Comparisons	D. F.	Sum of squares	Mean variance	Value of z	
				Observed	5 per cent.
Nitrogen <i>vs.</i> no nitrogen . . . . .	1	104.91	104.91	0.7849	0.7205
Different doses of nitrogen . . . . .	1	99.32	99.32	0.7575	0.7205
Treatment . . . . .	2	204.23	102.12		
Error . . . . .	26	567.88	21.83		
Total	28	772.11			

TABLE VIII.

(Flowers : Buds).

Comparisons	Mean proportion of flowers : buds	Difference from	
		Control	40 lbs. nitrogen
No manure . . . . .	25.7	—	—5.7
40 lbs. nitrogen . . . . .	31.4	+5.7	—
100 lbs. nitrogen . . . . .	36.3	+10.6	+4.9

Standard error of the difference in means=2.08.

The application of nitrogen is associated with a significant increase in the percentage success of buds growing into flowers. The additional dose of nitrogen too is effective in diminishing the rate of shedding of buds.

6. The analysis of the percentage success of flowers developing into bolls is given in Tables IX and X.

TABLE IX.

(Bolls : Flowers).

Comparisons	D. F.	Sum of squares	Mean variance
Nitrogen <i>versus</i> no nitrogen . . . . .	1	3.24	3.24
Different doses of nitrogen . . . . .	1	4.20	4.20
Treatment . . . . .	2	7.44	3.72
Error . . . . .	26	180.61	6.95
Total	28	188.05	

The residual mean variance is larger than that due to treatment, which at once indicates that the treatments are ineffective in diminishing the rate of shedding of flowers before the boll stage.

TABLE X.

(Bolls : Flowers).

Comparisons	Mean proportion of bolls : flowers	Difference from	
		Control	40 lbs. nitrogen
Control . . . . .	32.3	..	-1.2
40 lbs. nitrogen . . . . .	33.5	+1.2	..
100 " " ; . . . . .	32.5	+0.2	-1.0

Standard error of difference in means = 1.20.

The differences are all statistically negligible. Thus nitrogen has no effect on the rate of shedding of flowers.

7. The analysis of the percentage success of buds developing into bolls is given in Tables XI and XII.

TABLE XI.  
(Bolls : Buds).

Comparisons	D. F.	Sum of squares	Mean variance	Value of <i>z</i>	
				Observed	5 per cent.
Nitrogen <i>versus</i> no nitrogen . . . . .	1	46.77	46.77	1.7544	0.7205
Different doses of nitrogen . . . . .	1	8.42	8.42	0.8071	0.7205
Treatment . . . . .	2	55.19	27.59		
Error . . . . .	26	36.32	1.40		
Total	28	91.51			

TABLE XII.  
(Bolls : Buds)

Comparisons	Mean proportion of bolls : buds	Difference from	
		Control	40 lbs. nitrogen
Control . . . . .	8.56	..	-2.04
40 lbs. nitrogen . . . . .	10.60	+2.04	..
100 .. .. . . .	11.93	+3.37	+1.33

Standard error of difference in means=0.37.

Apparently nitrogen has some effect on the percentage success of buds developing into bolls, and there is a response due to the increased dose of nitrogen.