Journal of Physical Science and Innovation
Volume 14, Number 2, December 2022
ISSN: 2277-0119
http://www.cenresinjournals.com

Statistical Study of the Effects of Four Different Fungicides on the Growth and Yield of Beans (*Phaseolus vulgaris* L) via a Control

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ABSTRACT
In this research work, Statistical Analysis of the Effect of Four Different Fungicides on the Growth of Beans (*Phaseolus vulagaris*), we applied the univariate data analysis on the growth characteristics of *Phaseolus vulgaris* via an untreated check (control) by considering four factors; the Harvest Yield, the Herbage Yield, the Mean Number of Flowers and Mean Height. There were a total of one thousand four hundred seeds, all of which were of the same species and of the same characteristics. Two hundred of these seeds were not treated with any of the fungicides while every other two hundred of the remaining were treated with four fungicides, Chinoin Fundazol, Agrocit, Anthracol and Difolatan. The experiment was performed using the Randomized Complete Block Design (RCBD). The analysis was further improved using the Multivariate Analytical Technique. It was concluded that no significant differences exist in the Mean Harvest, Meam Herbage Yield and the Mean Height between the Fungicides treated seeds and that of the Control.
Keywords: Phaselus Vulgaris, Herbage Yield, Mean Height, Harvest Yield.

INTRODUCTION

Agriculture is an integral part of the economy that needs proper management by trained personnel and experts if the sector is to play its giant role as a last resort against famine and hunger effectively. One important role among others is the provision of food at any particular season of the year for the ever-increasing population. Realizing this important role, most nations of the world have launched numerous programmes to boast food production and Nigeria is no exception. "The operation feed the Nation", the "Green Revolution Schemes" and the "Back to Land".

The Federal and State Governments have always recommended and supported Agricultural Loans and Aids to farmers and researchers in the field of Agriculture. Some of these aids are the allocation of fertilizers, pesticides, fungicides, herbicides etc to farmers and agricultural researchers so as to boast food production. Some major problems facing farmers and agriculturists in the country are lack of storage facilities for farm product, control of pests and pathogenic organisms that causes damage to agricultural products and livestock. Researchers and Experimenters have endlessly continued to experiment in order to find better agricultural inputs like fertilizers, herbicides, pesticides, fungicides, fumigants and other related chemicals which check the effects of parasites, pests, fungi, germs etc and at the same time boast production.

The term bean is broadly interpreted to include all field and kidney bean of any colour, size or shape as well as lima beans and tepary beans. There are many species in the genus Phaseolus, which include *Phaseolus vulgaris* L –commonfield or kidney bean. *Phaseolus coccineus* L – Scarlet Runner bean, *Phaseolus actifolus* Graw – Tepary bean, *Phaseolus aconitifolus* Jacq – Maf or Moth bean, **Phaseouls angularis** (Willd) wight – adzuki bean, *Phaseolus calcaratus* (Roxb) – Rice bean, *Phaseoulus lunatus* – Lima, Sieva or butter bean. Of these, the *Phaseolus vulgarism* L is the most important of the food grain legumes grown in the tropics and subtropics. It is the best known and most widely cultivated species of Phascolus. *Phaseolus vulgaris* L are grown for their dry seeds and immature edible pods, and to a lesser extent for green-shelled

Journal of Physical Science and Innovation
Volume 14, Number 2, December 2022
ISSN: 2277-0119
http://www.cenresinjournals.com

beans. In humid areas, the crop suffers from many diseases, most of which are rarely problems in the dry and semi-arid areas.

Anthracnose (*Collectorichum lindemuthianum*) is one of the most destructive diseases caused of the beans worldwide. Elongated dark red cankers occur on the stem and leaf veins and suckers' sports with oink centers and darker orders appear on the pods. Cold wet weather favors Anthracnose attacks. It is carried bydiseased seeds so it is essential to use diseased seeds, preferably from an arid area. Root rot is caused by Fusarium oxysporum. The first symptom is a red discoloration of the taproot, which turns brown and the roots become dry and peppery. There did no effective chemical control for this disease, the pathogen persist in the soil and the only long-term rotation is truly effective.

Rust (Uromyces Phaseolis) is also found worldwide. It produces reddish ureedospores and later dark brown leleutospores, mainly on the leaves. This disease can only be avoide br growing resistant cultivars. Foliar blight: several bacterial that cause foliar blight also attack the beans. Control is achieved mainly through disease free seed that is produced in semi-arid environment. Common bean mosaic; a seed borne virus, which also transmitted by aphids from diseased to healthy plants, may cause loses in all areas. The only effective control measure is the use of resistant cultivars.

The beans are attacked by various insects, including beans weevils (bruchus spp). Been beetle (Acanthosclides obtectus) and cowpea beetles (Collosobruchus spp) that feed on the beans, as wed leaf hoppers, aphids and such insects as the bean fly (Melang agromyza phaseoli) that transmit virus.

Bean weevils are controlled through the use of weevil free seeds for sowing and through the sanitation and fumigation of storage facilities. Out-breaks of plant infesting beetles and larvae may be treated by dusting with Malathion or other appropriate insecticides. To prevent initial infection by insects, which transmit viruses from border plants, weed growth bordering the filed should be eliminated before the bean crop is sown.

DESIGN AND DESCRIPTION OF THE EXPERIMENT

This experiment was designed and conducted using the Randomized Complete Block Design (RCBD) to determine the effectiveness of four different fungicides on the growth of Beans (*Phaseolus vulgaris* L) via a control

Four stages of growth of the crop were considered. They are the Herbage Yield, the Mean Number of Flowers, The Mean Height and the Harvest Yield. The application of the fungicides were made first on the bean seedlings before sowing and secondly on the plots in each block of seven blocks experiment on which seeds were sown. The aim is to kill the fungi that might have infected the seeds and those that might be living in the soil respectively. There were a total of one thousand and four hundred (1400) seeds, all of which were the same characteristics, two hundred (200) of these were untreated with any fungicide, while every other two hundred of the remaining one thousand and two hundred (1200) were treated with

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http://www.cenresinjournals.com

a. CHINON-FUNDAZOL
b. AGROCIT
c. ANTHRACOL
d. DIFOLATAN

Fungicides respectively. The untreated plot and the four fungicides treated plots were chosen at random from each block also chosen at random from the seven blocks. Planting was done on the 17th June, 2022 with forty (40) seeds per plot. Germination counts are recorded ten days after planting. Since all the thirty five (35) plots did not have the same number of growing crops on them, measurements were carried out on a random sample of five plants from each plot of each block of the seven block experiments.

The first measurement was the herbage count which started on the 11th July, 2022 and was done every two weeks for five times. Second, was the height measurement in centimeters taken every two weeks for five times. Third, was the mean number of flowers taken once every week for three times. Then, the mean weight of plant harvest and finally the harvest yield in kilograms measured every week for four times. Thus harvesting of beans was concluded on the layout and definition of variables

Randomized Compete Block Design (RCBD)

b_1	b_2	b_3	b_4	b_5	b_6	b_7
C	D	B	E	A	B	A
E	A	D	C	B	E	D
A	B	C	D	E	A	B
D	C	A	B	D	C	F
B	E	E	A	C	D	C

The fungicides are:
A = Chinoin – Fundazol
B = Agrocit
C = Anthracol
D = Difolatan
E = Untreated check (control)

ANALYTICAL PROCEDURE

Model, Assumption and Definition of Variables

The Model is: $X_{ij} = u + t_i + b_j + e_{ij}$

Where $I = A, B, C, D, and\ E$

$J = 1,2,3,4, \ldots ,7$

X_{ij} = Response of the i^{th}treatment (Fungicide variation) in the j^{th} block.

Each x_{ij} is a four-component vector.

u = Overall (universal) constant
t_i = Effect due to the i^{th} treatment
b_j = Effect due to the j^{th} block
e_{ij} = Random error associated with x_{ij}

The Assumption ii that;

$$\sum_{i=1}^{5} t_i = \sum_{j=1}^{7} b_j = 0$$

$$e_{ij} \sim N(\mu, \sigma^2)$$

The above model is based on a multivariate normal distribution. The variations among the treatments are due to the four different fungicides and the control. The observations are measurements taken on the plants. The assumptions of normality, homogeneity of variances (Dispersion matrix in this case) and independence of factors (fungicides treatments) hold. Hence the population from which the samples were taken

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for p-correlated variables is that of a multivariate normal distribution with equal covariance matrices.

The experiment will be analyzed by considering the four parameters of the beans jointly.
These are:

i. The Herbage Yield (HBY)
ii. The Mean Height (MHT)
iii. The Mean Numbers of Flowers (MNF)
iv. The Harvest Yield (HVY)

Since these four characteristics were measurements taken on the plants, one cannot assume that they are independent unless on test for independence. Assuming normal distribution, the data have a multivariate normal distribution with mean vectors zero and variance – covariance matrix V. Hence a multivariate analytical procedure will be adopted depending on the outcome of the test for independence of the variates. From the table data, the component of each vector in each plot are tagged $x_{ij}'s$ in each x_{ij} the first component of vector is the Herbage Yield (HBY) the second is the Mean Height (MHT), the third is the Mean Number of Flowers (MNF) and the fourth is the Harvest Yield (HVY). The two last columns and the two last rows are the totals and means respectively.

Table 1: Compressed Table of Data Blocks

	B_1	B_2	B_3	B_4	B_5	B_6	B_7	T_i	$\bar{X}_I$
Treatment A									
HBY	60.84	60.84	65.56	91.00	65.14	63.14	67.56	472.46	67.49
MHT	89.76	89.79	93.24	126.10	84.72	108.12	109.08	692.30	98.90
MNF	54.13	45.40	67.00	53.10	54.87	63.20	74.60	412.30	58.90
HVY	2.44	1.34	3.29	2.93	2.04	2.58	2.89	16,66	2.38
Treatment B									
HBY	57.96	64.68	58.64	53.68	80.20	58.99	55.96	430.00	61.43
MHT	90.36	108.28	86.68	86.36	103.04	100.00	104.48	679.48	97.03
MNF	53.47	70.73	52.81	54.73	58.50	68.63	46.93	405.16	57.88
HVY	1.00	2.40	1.11	2.31	4.50	2.94	1.49	15.75	2.25
Treatment C									
HBY	50.32	68.48	57.30	57.12	88.69	57.32	58.96	438.19	62.63
MHT	74.40	122.68	81.00	101.20	132.64	101.12	100.92	713.96	101.99
MNF	58.93	75.27	51.50	51.50	68.33	66.87	74.07	446.50	63.79
HVY	1.38	2.20	1.75	2.26	1.38	1.01	2.24	12.82	1.83
Treatment D									
HBY	43.88	53.24	54.15	85.68	104.38	51.52	59.22	452.57	64.65
MHT	69.68	93.28	89.64	93.16	93.40	92.40	126.64	658.40	94.06
MNF	56.20	57.47	65.47	57.73	44.33	59.80	57.27	398.27	56.90
HVY	0.99	2.68	2.10	2.73	1.84	1.04	3.54	14.92	2.93
Treatment E									

HBY	37.52	50.13	48.20	58.16	66.43	81.88	64.48	405.10	57.87
MHT	54.16	67.30	41.20	83.92	98.50	104.76	101.20	551.54	78.79
MNF	48.00	72.17	61.80	60.98	67.25	61.60	57.02	428.77	61.25
HVY	1.12	1.15	1.72	2.20	1.82	3.13	1.86	13.00	1.86
T_j									
HBY	250.82	295.13	283.85	345.64	404.84	313.36	304.68	2198.32	
MHT	378.36	473.82	390.76	490.74	512.30	506.40	543.02	3295.40	
MNF	269.78	298.04	298.54	278.58	293.58	320.10	309.89	2091.00	
HVY	6.08	9.77	9.77	12.43	11.58	11.30	12.02	73.15	
X_j									
HBY	50.16	59.03	56.77	69.13	80.97	62.67	60.94		62.81
MHT	75.67	94.76	78.15	98.15	102.46	101.28	108.61		94.15
MNF	53.96	64.21	59.73	55.68	58.72	64.02	61.98		59.74
HVY	1.22	1.96	1.99	2.49	52.32	2.26	2.41		2.09

UNIVARIATE ANALYTICAL TECHNIQUE

$$X_{ij} = u + t_i + b_j + e_{ij}$$
$$i \quad = A, B, C, D, and\ E$$
$$j \quad = 1,2,3,4, \dots ,7$$
$$\sum_{i=1}^{5} t_i = \sum_{j=1}^{7} b_j = 0$$
$$E(e_{ij}) \ = 0$$
$$e_{ij} \sim N(\mu, \sigma_e^2)$$

Assumptions:

NORMALITY: It is assumed that the random variables in the model were normally distributed.

$$e_{ij} \sim N(\mu, \sigma_e^2)$$
$$x_{ij} \sim N\left(\mu\, \bar{x}, \sigma_e^2\right)$$

Where $\mu\, \bar{x} = E\left(x_{ij}\right)$

HOMOSCEDASTICITY OF VARIANCE:

It is assumed that the random variables in the model have a constant variance. Since the experiment is a randomized complete block design, the component of error contributed by the four fungicides treatment all estimates of a common population variance. Hence,

$$Var\ \left(e_{ij}\right) = \ \sigma_e^2 = Constant$$
$$Var\ \left(x_{ij}\right) = \ Var\ \left(e_{ij}\right) = \ \sigma_e^2 = Constant$$

INDEPENDENCE

It is also assumed that the random variables in the model are mutually independent and independently distributed.

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ISSN: 2277-0119
http://www.cenresinjournals.com

$$e_{ij} \sim N(\mu, \sigma_e^2)$$
$$E(e_{ij}, ei^i j^i) = oV_i \neq i^i; \quad j = j^i$$

Estimation of Parameters in the Model and Calculation of Sums of Squares.

Since the RCBD is very similar to that the two-way crossed ANOVA with one observation per plot and no interaction, then it can be analyzed in the same way as the two-way crossed ANOVA. The least square estimates of the parameters are, employed since LSE is the best linear unbiased estimate.

$$X_{ij} \quad = \quad a_0 + t_1 + b_1 + e_{ij}; \qquad i = 1,2, \dots ,5$$
$$\therefore e_{ij} \quad = \quad X_{ij} - a_o - t_i - b_j$$
$$(e_{ij})^2 = (X_{ij} - a_0 - t_i - b_j)^2$$

$$L = \sum_{i=1}^{5} \sum_{j-1}^{7} (e_{ij})^2 = \sum_{i=1}^{5} \sum_{j=1}^{7} (X_{ij} - a_0 - t_i - b_j)^2$$

With respect to a_0, t_i and b_j, we fin the first derivatives and equate to zero for minimum or maximum.

$$\frac{dL}{da_0}(a_0, t_i, b_j) = -2 \sum_{t=1}^{5} \sum_{j=1}^{7} (X_{ij} - a_0 - t_i - b_j) = 0$$

$$\frac{dL}{da_0}(a_0, t_i, b_j) = -2 \sum_{t=1}^{5} \sum_{j=1}^{7} (X_{ij} - a_0 - t_i - b_j) = 0$$

$$\sum_{i=1}^{5} \sum_{j=1}^{7} X_{ij} = -\sum_{i=1}^{5} \sum_{j=1}^{7} a_0 - \sum_{i=1}^{5} \sum_{j=1}^{7} t_i - \sum_{i=1}^{5} \sum_{j=1}^{7} b_j$$

$$\sum_{i=1}^{5} \sum_{j=1}^{7} X_{ij} = -\sum_{i=1}^{5} \sum_{j=1}^{7} a_0 - \sum_{i=1}^{5} \sum_{j=1}^{7} t_i - \sum_{i=1}^{5} \sum_{j=1}^{7} b_j$$

$$a_o = \frac{\sum_{i=1}^{5}\sum_{j=1}^{7} X_{ij}}{3.5} = \frac{T..}{35} = \bar{X}..$$

Similarly,

$$\frac{dt}{dt_i} = 0, \qquad t_i = \bar{X} - \bar{X} \ldots$$

Where

$$X_{ij} = \frac{\sum_{j=1}^{5} X_{ij}}{i} = \frac{\sum_{j=1}^{5} X_{ij}}{5} = \frac{T.j}{5}$$

$$e_{ij} = X_{ij} - a_0 t_i - b_j$$

$$= X_{ij} - X \ldots - (\bar{X}_i - \bar{X}) \cdots (\bar{X}_j - \bar{X})$$

$$= X_{ij} - \bar{X}_j + \bar{X}_j$$

With the control is not rejected.

Estimation of Efficiency of Randomized Complete Block Design (RCBD) Relative to a Completely Randomized Design (CRD)

Since the block effects are insignificant in the harvest yield, one world naturally questions the rationale behind blocking in this experiment. Has there been gain in efficiency or precision by the use of the RCBD relative to a CRD? Has the scope of the experiment increased since the treatments were tested over a wider range of experiment conditions?

The answer of these questions lie only in calculations whether there is gain in efficiency by the use of the design relative to the CRD. The efficiency (RCBD)/(CRD) is given by

$$\left[\frac{(f_1+1)(f_2+3)\ MSE\ (CRD)}{(f_1+1\ )(f_2+3)\ MSE\ (RCBD)}\right] \times 100$$

$$\frac{Eff(RCBD)}{CRD} = \frac{MSE\ (CRD)}{MSE\ (RCBD)} \times 100$$

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Volume 14, Number 2, December 2022
ISSN: 2277-0119
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$$MSE\ (CRD) = f_b\ MSB + \frac{(f_t + f_e)\ MSE}{f_b + f_t + f_e}$$

Where
f_b = block degree of freedom
f_t = treatment
f_c = error degree of freedom

MSE = block mean square
MSE = error mean square

$$MSE\ (CRD) = \frac{6 \times 0.64 + (4 + 24) \times 0.65}{6 + 4 + 24}$$
$$= \frac{564 + 18.2}{34}$$
$$= 0.701$$

$$MSE\ (RCBD) = 0.65$$
$$\therefore Eff\ (RCBD)(CRD) = \frac{MSE(CRD)}{MSE(RCBD)} \times \frac{100}{1}$$
$$= \frac{0.701}{0.65} \times \frac{100}{1} = 108\%$$

By using the Randomized Complete Block Design (RCBD), information is not lost since, 108 (one hundred and eight) replicated in a completely Random Design gives as much information as 100 blocks on replications for randomized complete block design.

Multivariate test for Independence
Since measurements were taken on a sample of five plants in each plot, one would not assume that the varieties were independent.

Let $\underline{X}$ be P-component vector with p-varieties normal distribution (U, V) be partitioned according to Anderson (1994)

$$\underline{X} = \begin{pmatrix} X_1 \\ X_2 \\ X_3 \\ X_4 \end{pmatrix} \qquad \mu = \begin{pmatrix} \mu_1 \\ \mu_2 \\ \mu_3 \\ \mu_4 \end{pmatrix}$$

$$\left(\begin{array}{ccc|c} V_{11} & V_{12} & V_{13} & V_{14} \\ V_{21} & V_{22} & V_{23} & V_{24} \\ V_{31} & V_{32} & V_{33} & V_{34} \\ \hline V_{41} & V_{42} & V_{43} & V_{44} \end{array}\right) = \begin{pmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{pmatrix}$$

Such that

$$\underline{X} = \begin{pmatrix} X(1) \\ \\ X(2) \end{pmatrix} \qquad \mu = \begin{pmatrix} \mu(1) \\ \\ \mu(2) \end{pmatrix}$$

And

$$V = \begin{pmatrix} V_{11} & V_{12} \\ V_{21} & V_{22} \end{pmatrix}$$

Be vector of means and covariance's. The vectors $X_{(1)}$ and $X_{(2)}$ are correlated normally distributed variables. The hypothesis that the variation in the $X_{(2)}$ set is independent of that among the $X_{(1)}$ set is equivalent to the hypothesis that is linear regression equation.

$$X_{(2)} = \mu_2 + B_{12}\left(X_{ij} - \mu_i\right) + E_{ij}$$

$$I = \begin{bmatrix} X_{(1)} \\ X_{(2)} \end{bmatrix} \; i = 1,2,3, \dots ,35$$

The regression coefficient between $X_{(1)}$ and $X_{(2)} - B_{12} = 0$

$X_1 =$ Herbage Yield
$X_2 =$ Means Height

Journal of Physical Science and Innovation
Volume 14, Number 2, December 2022
ISSN: 2277-0119
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X_3 = Mean Number of Flower
X_4 = Harvest Yield

For independence, the hypothesis specifies

$$B_{12} = 0$$
$$H_0 : B_{12} = 0;$$

$$V = \begin{bmatrix} V_{11} & 0 \\ 0 & V_{12} \end{bmatrix}$$

The text statistic is the wilks test criterion

$$W = \frac{(V)}{(V_{11}) \cdot (V_{12})}$$

$$S = \frac{(S)}{(S_{11}) \cdot (S_{12})}$$

Is the unbiased sample variance – covariance matrix estimate of W partitioned according?

$$S = \begin{pmatrix} S_{11} & S_{12} & S_{13} & | & S_{14} \\ S_{21} & S_{22} & S_{23} & | & S_{24} \\ S_{31} & S_{32} & S_{33} & | & S_{34} \\ - & - & - & | & - \\ S_{41} & S_{42} & S_{43} & | & S_{44} \end{pmatrix} = \begin{pmatrix} S_{11} & | & S_{12} \\ - & | & - \\ S_{21} & | & S_{22} \end{pmatrix}$$

And this is the SSCP matrix due to error. Then,

$$-\left\{f_1 - \frac{1}{2}(p - f_2 + 1)\right\} \log_e W \ \sim c(p, f_2 m) x_2 p_{12}$$
$$M = f_1 - p - 1$$

$f_1 =$ Error degree of freedom $N - f_2 - 1$
$f_2 =$ Hypothesis degree of freedom (in case treatment f.f)
$p =$ Number of varieties
$\alpha = 0.05$
Decision Rule: The Null Hypothesis

$H_0 : \beta_{12}$= (i.e. varieties are independent) is rejected in favour of $H_1 : \beta_{12}$ if at the level of significance $\alpha = 0.05$

$$U = \frac{\left\{f_1 - \frac{1}{2}(p - f_2 + 1)\right\} \log_e W > \alpha 2\ (pl\ 2\ 1 - \alpha)}{C(pl\ f_2, m)}$$

Accept $H_0 : \beta_{12} = 0$, otherwise where the constant $C(pl\ f_2, m)$ is obtained from the biometrical table for statisticians (table 47) Partitioning the SSCP matrix due to error $Ke(s)$ accordingly.

$$S = \begin{pmatrix} 3340.25 & 2322.53 & -101.40 & 59.05 \\ 2322.53 & 11344.09 & 609.97 & 90.42 \\ -101.40 & 609.97 & 4153.08 & 83.19 \\ 59.05 & 9042 & 83.19 & 15.58 \end{pmatrix}$$

$$W = \frac{|S|}{|S_{11}||S_{22}|} = \frac{1.689 \times 10^{12}}{1.333 \times 10^{11} \times 15.58}$$

$$W = 0.813$$

$f_1 = 30$ (Error d.f)
$f_2 = 4$ (Treatment d.t)
$p = 4$ (Numbers of variants)

$$M = 30 - 4 + 1 = 27$$
$$C(p_1 f_2 m) = C(4,4,27) = 1.0039$$

At $\alpha = 0.05$

$$\therefore U = -\left\{30 - \frac{1}{2}(4 - 4 + 1)\right\} \log 0.813\ \sim \alpha^2 16_{0.05}$$
$$U = 6.08 \quad \alpha^2 16_{0.95} = 26.2962$$

Decision: Since $6.08 \quad 26.2962$, the null hypothesis $H_0 : \beta_{12} = 0$ is not rejected. Hence,
The $\underline{X_2}$is independent of X hence we conclude that the harvest yield is independent of the herbage yield, mean heigh and mean number of flowers.

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Volume 14, Number 2, December 2022
ISSN: 2277-0119
http://www.cenresinjournals.com

SUMMARY AND CONCLUSION

From the various tests of hypotheses on the four varieties of Phaseolus vulgaris tested with the four different fungicides from those of the control, the null hypothesis of no significant differences in the mean yields were not rejected. This implies that;

i. There is no significant difference between the mean harvest of the four seed fungicides and the mean harvest yield of the untreated check.
ii. There is no significant difference between the mean herbage yield of the four seed fungicides and the herbage yields of the untreated check.
iii. There is no significant difference between the mean heights of the four seed fungicides and the mean height of the untreated check.

The four histograms constructed for the herbage contribution to yield by the fungicides marginal contribution to yield by the fungicides than the control not statically significant. The bean seeds and the soil might not have been infested to the percentage of giving significant result. The fungicides used chino-funder of Agrocit, Anthracol and Ditolaran were no fertilizers and no period was any fertilizer applied. Furthermore, from the analysis of block effects, the null hypothesis is equal block effects or insignificant block effects were rejected for the herbage and height analysis. This implies that the environmental and or physical factor being blocked for were really present. For flowering and harvest analysis of blocks effects whose null hypothesis of insignificant block effects were accepted. The estimation of efficiency of Randomized Complete Block Design

(RCBD) relative to the Completely Randomized Design (CRD) showed that precision was gained. Finally, we would point out that a lot of approximations and means over means were made to get the data to the form to which our statistical model can apply. These approximations may under-estimate or over-estimate the statistic for testing the hypothesis. There could also have been some extraneous variables, which affected the crops, which the experimenter had no control over. Such extraneous variables could be rain, which could wash away the treatments (fungicides) applied to the soil since the period between planning to harvesting fell into the rainfall period peak periods of the year.

RECOMMENDATIONS

Although the more the number of blocks in a Randomized Complete Block Design the more the gain in precision of the experimenter, but as regards resources which are undoubtfully limited and scarce, and likely to offset that of accuracy (precision) smaller number of blocks is suggested that this be carried out once again, either with the same, specie of beans or another, this time, with surety that the seeds and soil be infested such that any treatment application be it fungicides or another would give a reasonable conclusive statistical result

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Journal of Physical Science and Innovation
Volume 14, Number 2, December 2022
ISSN: 2277-0119
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