International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

The Effect of Homogeneity on Some Selected "Downy Mildew" Resistant Maize Varieties on Plant Yield Over the Height and Stand

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ABSTRACT

This research was carried out to determine the effects of twenty-two varieties of Downy Mildew resistance maize on the plant yield, height, and stand. The Analysis of variance techniques were used to analyze the data on the plant yield, height, and stand. Test of homogeneity of the variance of the treatments was carried out and it was found that the variances are homogeneous for each case (yield, height, and stand). Hence, we proceeded further to analyze the variance technique. We also analyzed the data on the plant yield, height, and stand. This study carried out revealed that the varieties effects on the plant yield, height, and stands are uniform. Also, the analysis of covariance test was carried out to reduce the experimental error. In this analysis, it was discovered that the varieties effects on the plant height and plant stand are the same.

1.0 INTRODUCTION

Agriculture is considered the largest sector in Nigeria's economy. "It is the second largest source of national wealth, after oil" (National Planning Commission, 2004). In addition to its contribution to the Gross Domestic Product, agriculture also accounts for 88% of the non-oil foreign exchange earnings (Ajekigbe, 2007) and since independence, it has been the most important economic sector in terms of its contribution to the Gross Domestic Product (Adegeye, 1993). The sector contributes about 41% of the country's GDP, employs about 65% of the total population and provides employment to about 80% of the rural population (Abdullahi, 1986). It was revealed from statistics that total food production increased from 54.76million grain equivalent in 1997 to 57.70 million grains equivalent in 2001 (Akinyemi,1998). Agricultural growth rates increased modestly from 4.25% in 1997 to 4.5% in 1999, 4.7% in 2004 (CBN, 2005). Naturally, Nigeria is blessed with abundant human (140 million people) and land resource (98.3 million hectares). About 72 million hectares are actually cultivable. But only 34 million hectares are presently under use.

According to Ajekigbe (2007), the Federal Government's budget on agriculture has increased by 20% per annum since 2003.

In Agricultural experiments, the Agronomist tries to classify plots into replications in such a way that soil fertility and growing conditions are as well uniform as possible within any replication. In this process, he utilizes any knowledge that he has about fertility gradients, drainage, liability to attack by pest etc one guiding principle is that in general, plot that are close together tend to give similar yields. Replications are therefore usually compact areas of land. Within each replication, one plot is arranged to each treatment at random. This experimental plan is called Randomized Blocks, the replication being a block of land.Apart from Agricultural field statistical, experiment is very important and useful in many fields like biological related studies, academic, physics,Agriculture, chemistry to mention but just few.

1.1 HISTORY OF MAIZE

Maize (ZEA MAY L), or corn as it is called in U.S.A., is a cereal crop which thrives well in a well drain loam and soft-loams with fine tilt. It is propagated by seed.

The planting period is between mid Marchs to early April (early maize), late August to mid September (late maize)

The planting distance is 80cm between rows. It is usually planted at four or five seeds per hole which may later be thinned to two or three seedlings per stand.

It requires regular weeding for the first six weeks of planting. It requires annual rainfall of about 6.00 to 12.00 mm. it can be planted on ridges or on flat land which could not be easily leached or eroded. It takes up to 13 – 16 weeks before it matures.Maize has a multitude of uses and ranks second to wheat among the world's cereal crops in terms of total production. Also, because of its World – wide distribution and low prices relative to other cereals, maize has a wider range of uses than any other cereals. Within the developing world, there are number of country where maize is a major staple food and the per capital human consumption reaches high levels.

Maize can be processed into different productions for various end uses at the traditional level and on an industrial scale. While a large proportion of products utilized in developing countries are obtained via traditional processing, industrial scale processing meets the bulk of the demand in developed countries.

However, significant changes are occurring throughout the developing countries in the processing of maize for major uses. The tendency is towards the adoption of simple processing machines for dwelling, dry and wet milling operations.

Moreover, in some developing countries like Nigeria, a few commercial maize processing mills are in operation producing brewers' grits, maize flour and maize meal. Nonetheless, it is pertinent to know that just over 40% of total world utilization of maize occurs in developing world which also account for the bulk of the direct human consumption of maize.

A vast array of maize varieties including local and improved varieties is grown by commercial and subsistence farmers. Certain maize types are used by consumers to produce the major food products in a given area.

1.2 DISEASE (DOWNY MILDEW)

Though, the focus of this research work is not per say on the Downy Mildew disease but basically on the maize that can resist this disease. But just to let the people know about this disease and know how it affects the maize.

Downy Mildew (PERENOSCLEROSPORA SP) is a fungus disease that has been recognized as a serious threat to maize and sorghum crops world-wide since the 60's. Pale yellow streaks on the upper leaves are followed by the development of Downy Mildew, necrosis and browning, suckering, retarded development and no grain may be produced.

The IITA (INTERNATIONAL INSTITUTE OF TROPICAL AGRICULTURE) report for 1975 revealed that this Downy Mildew was found for the first time in Nigeria near Owo in the former Western state in a well fertilized seed multiplication plots. Examination of the area revealed that the disease was widespread and had been present for some years, but poorly expressed due to low standard of husbandry and fertilization. The disease exists for 100 miles north of the Owo area.

2.0 LITERATURE REVIEW

Adeolu (2014) noted the dominant pattern in Nigeria's agriculture as the small-scale farmers, who are often characterized by the use of unimproved farm implements and traditional production tools that are capable of generating only very small income to farmers. Their output is little, but when combined, supplies the lion share of the food consumed in the nation. Their major aim of productions is to feed themselves and their families with little or no sale. The total lands cultivated by small-scale farmers, at any time, is below 10 hectares, and /or have less than 500 poultry birds, goats, cattle, pigs; with little or no externally sourced inputs. This could be as a result of non-availability or inadequate supply of credit to the farmers. With all the contributions of the Federal Governments to ensure availability of credit, it is unfortunate that the credit has not reached the majority of rural poor or small-scale farmers as a result of complexity of the condition that must be met before these farmers could obtain the credits, although, since the political and economic reform of 1993, individual small-scale farmers have started to benefit from hiring agricultural machineries and planting of improved seed varieties bred and developed by Agricultural Research Institutes such as the International Institute of Tropical Agriculture, Ibadan. (IITA), National Centre for Agricultural Mechanization (NCAM), etc., this also was in short supply and short-lived.

Many researches had previously carried out work on performance of different varieties yield in Agriculture. While some carried out their own on some annual crops e.g. Maize, Cowpea, Millet, etc. Some carried out their own on biannual and perennial crops; our major focus on this research is to determine which varieties can be the best that can resist Downy Mildew disease in different ecological system in their height, yield and plant stand.

Corn which is a cereal crop or maize as it is popularly called is an indigenous to West Africa in general and to Nigeria in particular especially Yoruba land which is used to make pap (Eko), maize flour (Tuwo) and other things like "Sapala" etc. It is an important item in the diet of Nigerians as it is rich sources of carbon hydrate. International Institute of Tropical Agriculture has taken interest to experiment which of the existing varieties of maize can resist this disease (Downy Mildew) and gives the best yield.

The results obtained at the end of the experiment shows that there is no significant difference in different varieties which shows that the farmer can choose any one of his own choice to plant and leading to an increment in the farmers yield and adding to the increase in food supplied to the entire population beside this there are various food that can be gotten from maize depending on the tribe that handle it. Because of the general consumption of maize as one of the popular Agricultural product from tropical Africa including Nigeria, the research carried out so far testifies to the importance of maize in our society and should be given a priority as one of the foods produced in Nigeria.

Now, to talk about the experiment, experiments are carried out in order to test the validity of a hypothesis or to estimate the magnitude of any defect. The Physician who suspected that some hitherto untried drag will have a beneficial effect in the treatment of a disease will, if he is scientifically trained, frame his enquiry in terms of some suitable hypothesis and will the design an experiment to test this hypothesis.

Claims of advances in our knowledge of natural phenomena are not readily allowed by scientist, until the evidence has been subjected to a penetrating examination. Every detail of the experiment will be scrupulously examined by critics who are eager to expose any fault in the experiment which may invalidate the conclusion. Indeed, in some cases this attitude of skepticism may be carried too far.

R.A. Fisher says: "The other types of criticism to which experimental results are exposed is that the experiment itself was ill-designed or, of course, badly executed. If we suppose that the experimenter did what he intended to do, both of these points come down the question of the design, or the logical structure of the experiment. This type of criticism is usually made by what I might call a heavy weight authority. Prolonged experience or at least the long possession of a scientific reputation is almost a prerequisite for this line of attack."

The reason for carrying out the experiments in Agriculture, Medical field, etc arise out of the need to better the lots of the existing generation and to serve as a foundation upon which the future generation can build upon. In medical investigation, one method of determining the potency of a drug is direct comparison with an agreed standard in the following way, the drug is applied at a constant rate to an experimental animal and the dose at which death or some other recognizable event occur is noted. Here each arrival is the experimental units receiving one or two possible treatments. Under clinical investigation, it is almost advisable to conclude a control treatment in the investigation, as well as new treatments because the effect of new treatment may except in dramatic cases to be shown by a comparatively small change in proportion of small cures. In this application each patient is an experimental unit receiving one or two or more possible treatments

3.0 METHODOLOGY

In this chapter, the various statistical design techniques to be used in the analysis shall be discussed. The design adopted for this project work is a Randomized Complete Block Design (RCBD).

3.1 MODEL AND ESTIMATIONS OF PARAMETERS

The usual model for a Randomized Complete Block Design (RCBD) when both the block and treatment effects are fixed and there are "b" blocks (Replications) and "t" treatments is of the form;

$Y_{ij} = \mu + \tau_i + \beta_j + \varepsilon_{ij}$

For i= 1, 2, 3, ------------- t

j= 1, 2, 3, ------------- b

where;

Y_{ij} – the observation of the i^{th} treatment in the j^{th} block

μ- overall mean (constant)

τ_i – the i^{th} treatment effects

β_j – the j^{th} block effect

ε_{ij} – the experimental error

Assumptions underlying Analysis of Variance; $\varepsilon_{ij} \sim N(0, \sigma)$

$E(\varepsilon_{ij}) = 0$ and $E(\varepsilon_{ij})^2 = \sigma^2 \forall$ i & j

$\Sigma \tau_i = \Sigma \beta_j = 0$ and Y_{ij} are independent

3.2 TEST OF HYPOTHESIS ABOUT DIFFERENCE IN TREATMENT MEANS

We are interested in testing the equality of the treatment means. Thus, the hypothesis of interest is;

$H_0 : \tau_i = 0$ (There are no significant differences) against $H_1 : \tau_i \neq 0 \; \forall$ i

α at level of significance

Test statistic: $F_0 = \underline{MStrt}$

MSE

Decision Rule: Reject H_0 if $F_0 > F_{\alpha, V1, V2}$ i.e. F calculated > F tabulated, otherwise accept H_0

3.3 PARTITIOING OF SUM OF SQUARES

In a Randomized Complete Block Design, the total sum of squares can be partitioned into variations due to treatments, blocks, as well as random error, as shown below;

Let Y_{ij} be the total of all observations taken under treatment i^{th}

$Y_{.j}$ be the total of all observations taken in block j^{th}

Y.. be the grand total of all observations

N = tb be the total number of observations

Similarly,

$\bar{Y}_{i.}$ – it is the average of the observations taken treatment i

$\bar{Y}_{.j}$ – it is the average of the observations in block j

$\bar{Y}_{..}$ – it is the grand average of all observations

$$\sum_{I=1}^{t}\sum_{J=1}^{b} (Yij - \bar{Y}..)^2 = \sum_{I=1}^{t}\sum_{J=1}^{b}\{(Yi. - \bar{Y}..)^2 + (\bar{Y}.j - \bar{Y}..)^2 + (Yij - \bar{Y}i. - \bar{Y}.j + \bar{Y}..)\}$$

The table below shows the summary of the Analysis of Variance (ANOVA) technique

TABLE 1

ANALYSIS OF VARIANCE TABLE RCBD

SOURCE OF VARIATION	**DEGREE OF FREEDOM**	**SUM OF SQUARE**	**MEAN SQUARE**	**F-RATIO**
TREATMENT	t - 1	SStrt	$\frac{SStrt}{t-1}$	$\frac{MStrt}{MSE}$
BLOCK	b – 1	SSb	$\frac{SSb}{b-1}$	$\frac{MSb}{MSE}$
ERROR	(t – 1)(b -1)	SSE	$\frac{SSE}{(t-1)(b-1)}$	
TOTAL	**tb – 1**			

If the treatments and blocks are fixed, the expected value of the mean can be

$$E(MS\ Treatments) = \sigma^2 + \frac{b\sum_{i=1}^{t}\tau i^2}{t-1}$$

$$E(MS\ Blocks) = \sigma^2 + \frac{t\sum_{j=1}^{b}\beta j2}{b-1}$$

$$E(MS\ Error) = \sigma^2$$

However, the F-ratio test gives a general overview about the whole treatments and blocks effect as case may be. If hypothesis is rejected a further test may be done and this gives a specific classification on treatment means whether there are significantly different or not.

3.4 TEST OF HOMOGENEITY OF VARIANCE USING BARTLETT’S TEST

The treatments in the data are assumed to have equal variances as stated by the model used. To check for the validity of this assumption in the data, Bartlett provides a test for this task.

HYPOTHESIS:

$H_O: \sigma_1^2 = \sigma_2^2 = \sigma_3^2 = \ldots\ldots\ldots\ldots\ldots\ldots\ldots = \sigma_t^2$ VS $H_1: \sigma_i^2 \neq 0$

At α level of significance

TEST STATISTIC:

If there are "t" estimates " Sp^2 " ,each with the same number of degree of freedom " df " , the test criterion is

$$\chi_c^2 = \frac{B}{C} \sim \chi2\,\alpha\,(t-1)$$

Where;

$$B = 2.3026\{[\sum(n_i - 1)] \log_{10} Sp^2 - \sum(n_i - 1) \log_{10} S_i^2\}$$

and

$$C = 1 + \frac{1}{3(t-1)} \left\{ \sum\left(\frac{1}{ni-1}\right) - \frac{1}{\sum(ni-1)} \right\}$$

Where also,

n_i = Number of observation in the i^{th} treatment

t = Number of variances being compared

S_i^2 = Mean Square error for i^{th} treatment

2.3026 is a constant value

$$S_P^2 = \frac{\sum(ni-1)\,S_i^2}{\sum(ni-t)} = \text{Pooled Variance}$$

Basically, the Bartlett's test is used to test for whether "t" populations have equal variances, as required by the ANOVA model. The Bartlett's test is an all-purpose test and can be used for equal and unequal sample sizes.

Decision Rule: Reject H_O if $\chi_c^2 > \chi^2$ tabulated otherwise, accept H_O

3.5 ANALYSIS OF COVARIANCE (ANOCOVA) TEST FOR RANDOMIZED COMPLETE BLOCK DESIGN

MODEL:

The usual randomized complete block design model is given as;

$$Y_{ij} = \mu + \tau_i + \beta_j + \varepsilon_{ij}$$

For i = 1, 2, 3, ……………..t

j = 1, 2, 3, …………….b

The covariance model for a randomized complete block design is obtained by simply adding a term (or several terms) for the relation between the dependent variable Y and concomitant variable X. assuming this relation can be described by a linear function, we then obtain,

$$Y_{ij} = \mu + \tau_i + \beta_j + \beta(X_{ij} - X..) + \varepsilon_{ij}$$

Where,

μ is the overall mean

τ_i is the fixed treatment effects such that $\sum\tau_i = 0$

β_j is the fixed block effects such that $\sum\beta_j = 0$

β is the regression coefficient for the relation between Y and X

X_{ij}'s are the value of the concomitant variable

ε_{ij} are independent N(0, σ)

3.6 ANOVA FOR Y,X AND XY – RANDOMIZED COMPLETE BLOCK DESIGN

TABLE 2

SUM OF SQUARES OF PRODUCTS

SOURCE	**D.F**	**Y**	**X**	**XY**
BLOCKS	b – 1	$SSBL_Y$	$SSBL_X$	SSPBL
TREATMENT	t – 1	$SSTR_Y$	$SSTR_Y$	SSPTR
ERROR	(b – 1)(t – 1)	SSE_Y	SSE_X	SSPE
TOTAL	**bt – 1**	$\mathbf{SSTO_Y}$	$\mathbf{SSTO_Y}$	**SSPTO**

The adjusted process now ignores the line for block effects in the above table of ANOVA for X,Y and XY, as if this effect has thereby been eliminated and proceeds in a manner analogous to a completely randomized design

3.7 COVARIANCE ANALYSIS FOR TESTING TREATMENT EFFECTS IN A RANDOMIZED COMPLETE BLOCK DESIGN

TABLE 3

(a) SUM OF SQUARES OF PRODUCTS

SOURCE	**D.F**	**Y**	**X**	**XY**
TREATMENT	(t-1)	$SSPTr_Y$	$SSPTr_X$	SSPTr
ERROR	(b-1)(t-1) -1	SSE_Y	SSE_X	SSPE
SUM	**B(t-1)**	$\mathbf{SSTr_Y + SSE_Y}$	$\mathbf{SSTr_X + SSE_X}$	**SSPTr + SSPE**

TABLE 4

(b) ANALYSIS OF COVARIANCE

SOURCE	**ADJUSTED D.F**	**ADJUSTED SS**	**ADJUSTED MS**
TREATMENT	(t-1)	SSTr (ADJ.)	MSTr (ADJ.)
ERROR	(b-1)(t-1) – 1	SSE (ADJ.)	MSE (ADJ.)
SUM	**B(t-1) - 1**	**SS(Tr + E ; ADJ.)**	

The above table contains the analysis of variance without the block effects line. The total line is called "SUM" since it does not include block effects. The adjustment process is now entirely analogous to that for a completely randomized design.

We obtain for the "SUM" line as;

$$SS\ (Tr + E;\ adj.) = (SSTr_Y + SSE_Y) - \frac{(SSPTr + SSPE)}{SSTr_X + SSE_X}$$

$$SSE\ (adj.) = SSEY - \frac{(SSPE)^2}{SSE_X}$$

SSTr (adj.) = SS(Tr + E ; adj.) – SSE (adj.)

The degree of freedom for error and the "SUM" are reduced by one on account of the introduction of the concomitant variable X.

The statistic for testing the treatment effect is given as;

$$F^* = \frac{MSTr\ (adj.)}{MSE\ (adj.)}$$

HYPOTHESIS:

$H_0 : \tau_1 = \tau_2 = \ldots\ldots\ldots\ldots\ldots.. = \tau_i$

VS

$H_1 : \tau_i \neq 0\ \forall\ i$

Decision Rule: Reject H0 if $F^* = \frac{MSTr\ (adj.)}{MSE\ (adj.)} > F\alpha, (t-1),(b-1)(t-1) - 1$

Otherwise accept H_0

4.1 PRESENTATION AND ANALYSIS OF DATA

The analysis was carried out by employing the model of Randomized Complete Block Design of experiment. Under the analysis, the test of homogeneity of variances will be carried out but using the Bartlett's test. After this test of homogeneity, analysis of the variance technique called ANOVA will be used in the test of hypothesis.

Also,The analysis of covariance test will be carried out for further tests on varieties effects on the plant height and plant stand. This analysis will be carried out to reduce the experimental error.

HYPOTHESIS:

$H_0 : \tau_1 = \tau_2 = \ldots\ldots\ldots\ldots\ldots = \tau_i$ (There are no significant differences in the varieties effects on plant stand)

Against

$H_1 : \tau_i \neq 0$ Ʉ for at least one i (There are significant differences in the varieties effects on plant stand)

At $\alpha = 0.05$ level of significant

COMPUTATION OF SUM OF SQUARES

SST $= \sum_{I=1} \sum_{J=1} Y_{ij}^2$ - C.F.

Where,

C.F. $= \frac{Y^2..}{Bt} = \frac{(1217)^2}{3\times 22} = \frac{1481089}{66}$

= 22440.74

Now,

SST = $\{(12)^2 + (16)^2 + (18)^2 + \text{-----------} + (18)^2\}$ – C.F.

= 23511 – 22440.74

= 1070.26

SSTr $= \sum_{I=1} Y_{i.}^2 - \frac{Y..^2}{bt}$

= $\{(49)^2 + (52)^2 + \text{----------} + (59)^2\}$ – C.F.

= $\frac{67967}{3}$ – 22440.74

= 22655.67 – 22440.74

= 214.93

SSB= $\sum_{j=1}^{b} Y_{.j}^2 - \frac{Y..^2}{bt}$

= $\{(360)^2 + (419)^2 + (438)^2\}$ – C.F.

= $\frac{497005}{22}$ – 22440.74

= 22591.14 – 22440.74

= 150.4

SSE = SST – SSTr – SSB

= 1070.26 – 214.93 – 1250.4

= 704.93

TABLE 9

ANALYSIS OF VARIANCE TABLE (ANOVA)

SOURCE	D.F	SUM OF SQUARE	MEAN SQUARE	F
TREATMENT	21	214.93	10.23	0.61
BLOCK	2	150.40	75.20	4.48
ERROR	42	704.93	16.78	

TOTAL	**65**	**1070.26**		

From the F- table we have

$F_{21, 42 (0.05)} = 1.84$

Interpretation : since the Fcalculated < F tabulated , H_0 is accepted and conclude that there is no significant differences in the varieties effects on plant stand.

5.1 SUMMARY

This study carried out revealed that the varieties effects on the plant yield, height, and stands are uniform.Also, the analysis of covariance test was carried out to reduce the experimental error. In this analysis,it was discovered that the varieties effects on the plant height and plant stand are the same

5.2 CONCLUSION

In conclusion, the results obtained at the end of the experiment shows that there is no significant difference in different varieties which shows that the farmer can choose any one of his own choices to plant and leading to an increment in the farmers yield and adding to the increase in food supplied to the entire population beside this there are various food that can be gotten from maize depending on the tribe that handle it.

Also, it shows that the varieties effects are the same. The analysis indicates that there is no significant differences in the varieties effects on plant height and plant stand from the ANOVA.

5.3 RECOMMENDATION

The federal government should increase its effort in promoting and transforming agricultural sector as it is the second after petroleum resources sector contributing in the rapid growth of the national GDP and among all reduces the level of poverty and hunger.

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