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Effectiveness of Hybrid Seed in Ethiopia Quality Seed Enterprise, Bahir Dar Branch

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Abbreviations:

LSD: Least Significance Difference; CSA: Central Statistics Agency; QPM: Quality Protein Maize; CADU: Chillalo Agricultural Development Unit; SSE: Southern Seed Enterprise; ESE: Ethiopia Seed Enterprise; ASE: Amhara seed Enterprise; SPS: Seed Producer Cooperative; ADLI: Agricultural Development Lead Industrialization; BOARD: Bureau of Agricultural and Rural Development; MOARD: Ministry of Agriculture and Rural Development; NGO: Non-Governmental Organization; DZARC: Debre Zeit Agricultural Research Center

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Productiveness of seed (yield); Analysis of Variance (ANOVA); Design of Experiment (DOE).

1. Abstract

1.1. Background: In any agricultural economy seed production and its effectiveness are the main driving forces to increase the development of the country. However, Insufficient and inefficient hybrid seed may have various factors that originated from poor performance of the formal seed system and uses of fertilizers combined to soil and the year that the seed planting is the concern for this paper.

1.2. Objectives: Evaluate the performance of hybrid seed production and its effectiveness by determining the seed type and year of planting of the seed in order to verify the most productive hybrid seed from 2003/4 to 2006/7 E.c in Ethiopia hybrid seed enterprise, Bahir Dar branch, Chagni and Kunzla farmland development.

1.3. Method: Two factor factorial designs were a method implemented using ANOVA to get solution for the desired objectives. The difference between the factor levels of average production of yield and exactly which average production yield differ is further determined using Turkey's test.

1.4. Results: There is an average increasing of production of yield with increasing rate from year 2003/4 to 2004/5 whiles from the year 2004/5 to 2005/6 the average yield increasing with decreasing rate. The yield that produced in 2005/6 was maximum among the rest of three years, while in 2003/4 small amount of product was recorded. Maize, Sorghum bicolor, Soya bean, Teff and Wheat had been the maximum production harvested in the year 2005/6, 2006/7, 2006/7, 2005/6 and 2005/6 respectively.

1.5. Conclusion: There is a significant effect of type of seed on the production of yield in which Soya bean and Maize had the maximum product while Teff and wheat had the minimum yield relative to the rest type of seed that lead for the contribution of rejection region by kept other factor constant. The minimum amount of product of Teff was observed even if it usually used for food in Ethiopia, specifically in the form of injera and wheat also mostly used for bread and it has great role for different industrial product. Hence, I need to recommend the enterprise to do more to maximize the production of teff as equal as other hybrid seed type or it is recommended if other hybrid seed of Teff is planting.

2. Introduction

2.1. Background of the Study

This research paper worked to assess the effectiveness of Ethiopia

quality seed in Amahra Regional State, Bahir Dar branch, in Kunzla and Chagni quality seed farmland development, in terms of productivity of yield.

Seed is one of the most important sources of innovation particularly in resource constrained small farm environments. It carries the genetic potential of the crops, determining the upper limits on yield and even the productivity of other inputs [6]. Ethiopia is a predominantly agricultural economy, the agricultural sector providing about 52% of the GPD and 85% of employment to the rural force, generates 90% of the foreign exchange earnings and it's a major source of raw materials for domestic industries [2]. To develop the agricultural sector, seed play a critical role in increasing agricultural productivity that determines the upper limits of crop yield basically. Even if seed have a crucial role for development of agricultural sector, it is not satisfactory to say that seed by itself develops agricultural sector rather it is effective seed with in appropriate it puts like fertilizers, soil and climatic condition of the year.

The Ethiopia seed system is governed by polices stipulated in the public proclamations and regulation that were put in place in the early 1990 [1]. The main responsibility of implementing these policies is given to Ministry of Agriculture and Rural Development (MOARD) at federal level and to Bureau of Agriculture and Rural Development (BOARD) of the regional level. Ethiopia farmers are highly reliant in informal seed provision and local varieties (with no legal certification), which includes seed retained by farmers. Farmers to farmer seed exchange (bartering) and cooperative or Non-Governmental Organization (NGO) based seed multiplication and distribution. Regional seed enterprises and private seed companies are core objective of the government of Ethiopia Agricultural Development Lead Industrialization (ADLI) strategy was to raise cereal yields through a centralized and aggressive extension based on technological packages that combined fertilizer improved seeds and other better management practices [9].

The formal seed quality system was partially exercised is a much disorganized manner in some parts of the country as early as 1942. According to [2], the Ethiopian formal seed system was introduced five decades ago with the activities of crop improvement research by the existing research and higher/learning institutes. The seed production showed a better organized fashion under the Chillalo Agricultural Development Unit (CADU). Seed quality testing was recorded to be conducted as easy as 1972 by the CADU on its laboratory in Kulumsa. It was also recorded to have been started in other agricultural research centers like DebreZeit, Holeta, Bako, Alemaya and Awassa. Nevertheless the CADU activities were the pioneer in the introduction of partial seed quality control in Ethiopia [7]. Soil, water and genetic resources constitute the foundation up on which agriculture and world food security is based on these the least understood and most under-valued are crop genetic resources. They are also the resources most dependent up on our care and safe guarding. And they are perhaps the most threatened [7]. Maize is the most productive cereal in the country while wheat was the second until 2009. In 2009/10 wheat was surpassed by rice and sorghum, and its position was shifted to four the [4].

Mostly since the enterprises have many number of hybrid seed in the field they have been getting difficulties to distinguish the most productive seed within the year. Ethiopia Seed Enterprise (ESE) in Bahir Dar branch took the initiative of contractual hybrid seed such as Maize, Wheat, Teff, Mashla and Soybean seeds production in Kunzla and Chagni quality hybrid seed farmland development. A rising from this Bahir Dar Branch seed enterprise disseminating these improved seed for the farmers by packed in good protective cover and painting different insecticide to keep the quality of the seed. Hence, in this study it is intended to identify the most productive hybrid quality seeds within each year and distribute to farmers so that they enable to harvest sufficient amount of yield for basic needs and other expenditure.

2.2. Statement of the Problem

Overall, around 85% the development of Ethiopia is conducted in agricultural center [3] rather than industry even if the country holding a principle of ADLI. To conduct agricultural products it needs to give priority for inputs of farmers in the farmland.

In any agricultural economy seed production and its effectiveness are the main driving forces to increase the development of the country [7]. A fully functional seed supply system through which improves variety seeds to the farmers is a crucial input for sustained agricultural production. Farmers in Ethiopia affected by insufficient and inefficient hybrid seed that originated from poor performance of the formal seed system and combination of other inputs in the year that the seed is planting. Limited supply of farm inputs, lack of investment capital high production and imbalanced combination of seed with different factors are some of the problems that exist in local hybrid seed production. In this study which hybrid quality seeds and in which year of planting have more productive yield was harvested will be indentied in the farmland of the enterprise and finally assess the behavior that which seed should be distributed to the farmer to be more productive.

2.3. Scope of the Study

The study was limited to Ethiopia hybrid seed entropies in Amahra Regional State, Bahir Dar Branch. The study would try to address the contribution of hybrid seed within the year. We used data and relevant documents for the time period (in year) of 2003/2004 E.C to 2006/2007 E.C of hybrid seed that hybridized in Ethiopia seed enterprise, Bahir Dar branch on Chagnie and Kunzla farmland development.

2.4. Significance of the Study

The study covers community based hybrid seed effectiveness and analysis the performance of hybrid seed production through eval-

uation of the production and relevant factors utilization activities along different hybrid channels of seed, which includes a major input to formulate appropriate hybrid seed supply policies and procedure.

This information could also help to make appropriate decisions by hybrid seed producer famers, seed traders, seed users, investors and other, who need the information for their respective purpose. Besides, the research will serve as a useful reference for researchers and other personnel interested in the area of study.

3. Data and Methodology

3.1. Description of the Study

Amahra Regional state is located in the North Western and North Central Parts of Ethiopia and lie with in 90 and 23045' N 360 and 40030'E. It has a total area of 170,000 sqkm, which is divided into eleven administrative zones and Wereda. Ragged mountains, palatals, valleys and Gorges characterize its physical landscape. Bahir Dar is a capital city of Amahra Regional state and one of the leading tourist destinations in Ethiopia within a variety of attractions in the nearby Lake Tana and Blue Nile River within it has a total population of 221,991 [5].

The study was concerned about hybrid seed and its effectiveness within cooperative worker of the farmland development in Kunzla (Amhara region in Misraq Gojjam Zone liven woreda) and Chagnie (Amhara region part of Agew Awi Zone in Guangua woreda), which is far from 130km and 180km respectively from Bahir Dar.

3.2. Source of Data

The data collected from Ethiopian seed enterprise, Bahir Dar branch from the year 2003/4 up to 2006/7 E.C. The farmland development of the enterprise is located at Kungla and Chagni. The aim of the enterprise is hybridizing different seeds within specific plot of land and identifies the productive hybrid seed so that it will be disseminate to the farmers in a year. The data obtained by unconditional assistance of workers/experts in the enterprise.

3.3. The Study Variable

The dependent Variable considered in this study is the production of hybrid seed in kuntal at Bahir Dar city.

- The production of seeds (in kuntal) includes maize, teff, wheat ,soya bean and Sorghum bicolor

Independent variable is a variable that might have affected the performance of production of seeds which includes:-

- The year that the hybrid seed is produced
- The type of hybrid seed

3.4. Method of Data Analysis

3.4.1. Exploratory Data Analysis: Main purpose of this statistics is to provide an over view information was collected. The analysis of statistical data begins by describing the row data. The descriptive statistics is the method in which the collected data are organized and summarized. In our study we used mean plot, box plot, individual plot, dot plot and tabulated form to summarize and organized the results were illustrated.

3.4.2. Statistica Model Building: As its name indicate that the inferential statistics infers about the population depending on the sample data, and analysis and test hypothesis. Since population is characterized by numerical descriptive statistics. Inference is concerned with making inference about the population parameter based on the estimating sample data. This is using analysis of variance and different method of test that used to compare treatment means listed above.

3.4.3. Analysis of Variance (ANOVA): The Analysis of Variance (ANOVA) table contains elements called sums of square, degree of freedom and mean square of error the component of the pattern and residual. The sum of squares allows us to see what proportion of the variation is explained by the different parts of the pattern in the data. The residual sum of squares shows us what remains unexplained, whilst the residual mean square which estimates the variance of the unit should be as small as possible so that differences between the treatments can easily be detected [11].

3.4.4. Factorial Design: Factorial design is a process with two or more inputs that explores the output values for all possible combinations of input values to a business, production or manufacturing process [8]. Many experiments involve the study of the effects of two or more factors. In general factorial designs are most efficient for this type of experiment. By factorial design, we mean that in each complete trial or replication of the experiment all possible combination of the levels of the factors is investigated. When factors are arranged in a factorial design, they are often said to be crossed. The effect of the factor is defined to be the change in the response produced by a change in the level of the factor, frequently known as a main effect because it refers to the primary factors of interest in the experiment.

3.4.5. Hypothesis of the Study:

1. There is no significance effectiveness and production difference between groups of hybrid seed.
2. There is no relationship between demographic, socio economic factors and the quantity production supply of quality hybrid seed.
3. There is no significance effectiveness and production difference between different year that the seed produced.

In this two factor factorial design both the row and column factors (A and B) are equal interest.

The appropriate test of hypothesis for the two factor factorial design is:

1. Ho: $\alpha 1 = \alpha 2 = \alpha 3 = \alpha 4 = 0$

   H1: $\alpha i \neq 0$ at least one

2. Ho: β1= β2=β3= β4= β5=0

   H1: βj ≠ 0 at least one

3. Ho: (αβ) ij= 0 for all i&j

   H1: (αβ) ij≠0 at least one

The study of this research stands to used descriptive statistics by tabular form and drawing mean plot for each treatment versus the response Variable. The inferential analysis used to analysis the data by using Turkeys' test (common test for agricultural data; [8]) by cooperating with relevant software SPSS for the entire work of descriptive and inferential statistics for data analysis purpose.

3.4.6. Model assessments (Model Adequacy checking): Before the conclusions from the analysis of variances are adopted, the adequacy of the underlying should be checked. Due to this the formal test for no differences in treatment means requires certain assumptions that should be satisfied.

3.4.7. Normality Assumption: The errors are normally and independently distributed with mean zero and constant variance. If these assumptions are valid, the analysis of variance procedure is an exact test of hypothesis of no difference in treatment means. An extremely useful procedure is to construct a normal probability plot of residual. A very common detect that often shows up on normal probability plot is one residual that is very much larger than any of the others. Such a residual is often called outlier.

In practice, however, the normality assumption will usually not have exactly. Consequently, it is usually unwise to rely on the analysis of variance until the validity of these assumptions has been checked. Violations of the basic assumptions and model adequacy can be easily investigated by the examination of residuals.

3.5. Method of comparison among treatment: Suppose that in conducting an ANOVA for a fixed effete Model the null hypothesis is rejected. Thus, there are differences between the treatment means but knowing exactly which means differ is not specified. In this situation, further comparison and analysis among groups of treatment means may be use full. There are many types of comparison among treatment but the most common in agriculture and the simple method:-

Turkey's test: Suppose that the following an ANOVA results that the null hypothesis of equal treatment means have been rejected. We wish to test all pair means comparison.

To test all pair means comparison.

Ho: μi =0 Vs H1: μi # μj

Turkey's test declares two means significantly different if the absolute value of their difference (Table 3.3) exceeds Turkey's test of

$$T\alpha = q\alpha\,(a, N-a) * \sqrt{\frac{MSE}{n}}$$

Where q_{α} (a, N-a)→ Tukey tabulated value with different a and N-a.

N is total number of observation, 60, a is levels of the factor and n is number of replication for a combination of the factors. The level of significance α=0.05 was considered in the study.

4. Results

4.1. Exploratory Data Analysis

A mean plot of the factor, in (Figure 1), shows the pattern of estimated marginal means of production of yield within each seed type per year. The Figure suggested that the average production of yield harvested from Soya bean was maximum throught the year 2004/5 to 2006/7. In contrast the production yield of Teft was minimum. Average production of Wheat was minimum in 2003/4 but highly increased in 2004/5 and remains decreasing and steady in the year 2005/6 to 2006/7. The effects of seed type on the production of yield looks depend on year which leads to suspect an interaction effect between type seed and year. Here the enterprise is used similar amount of fertilizer, farm land size and as much as possible similar soil content for the sake of comparison of productivity of hybrid seeds in the plot of land and hence, in the analysis fertilizer, farmland size and soil types were considered as controlled.

Average production of yield throught the year was illustrated in (Figure 3) and it revealed that average production of yield was increased with increasing rate from year 2003/4 to 2004/5 while from 2004/5 to 2005/6 increased with decreasing rate and a decreasing trend from 2005/6 to 2006/7.

In order, the average yield that obtained from soya bean greater than that of maize, maize greater than that of sorghum bicolor, sorghum bicolor greater than that of wheat and wheat greater than that of teff.

From the box plot in (Figure 4) it can be seen that the yield of each seed type within each year. Median yield is highest in 2005/6 for maize, 2005/6 and 2006/2007 for soya bean 1250, 1265 and 1264 respectively. While there is least median yield is exist in 2003/4 from wheat seed type.

On the other hand there is a great variability is existed in wheat and S/bean seed type with in 633 and 419 standard deviation respectively. Contrast to this teff seed type is the least variability within 630 minimum and 660 maximum value of yield and with 21.2 standard deviation.

Relatively minimum amount of yield produced from teff seed type and maximum amount of yield recorded from S/bean. From maize, sorghum bicolor, soya bean, teff and wheat maximum product is harvested in the year 2005/6, 2006/7, 2006/7, 2005/6 and 2005/6 respectively.

Most product of yield in quintal was fastened with a yield of around 600 to 1200, (Figure 5). On the other hand there is dispersed product value produced from a yield amount 1200 to 1600 as well as from 200 amount of yield to 400.

From the descriptive statistics in (Table 1) has similar information with information obtained from the box plot in (Figure 4).

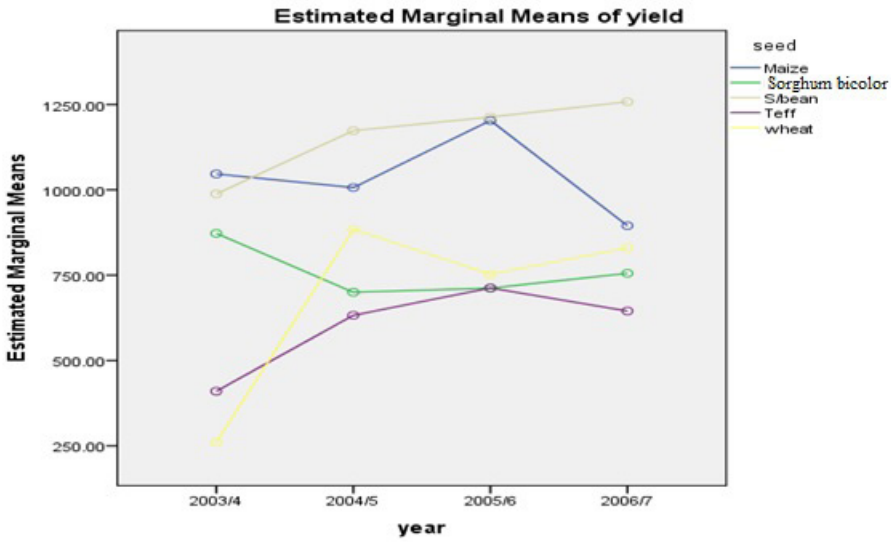


Figure 1: Interaction Mean plot of production of yield (y) for year and seed type

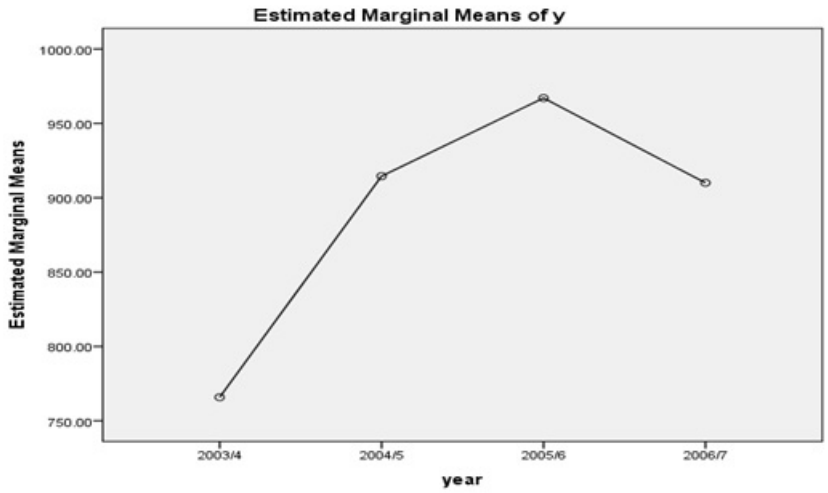
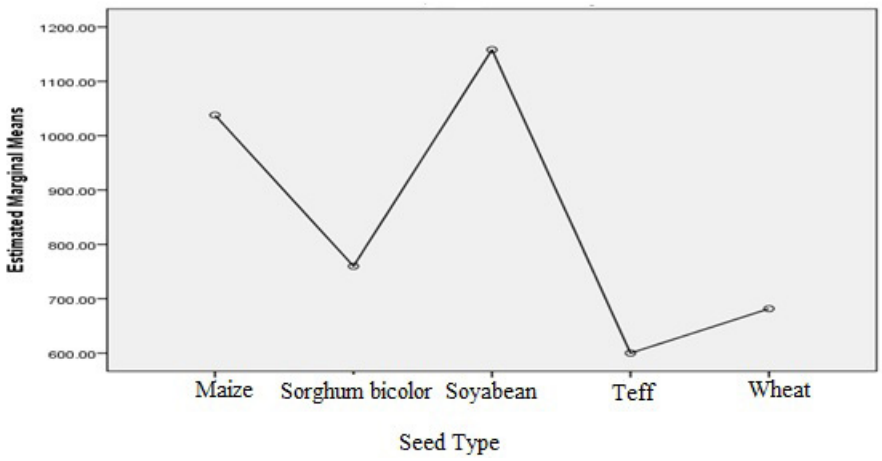


Figure 2: Mean plot of production of yield for each year



Likewise, average production of yield within each year, production of yield in average was recorded in (Figure 3) below. Average production of S/bean was the maximum product recorded while Teff was the minimum yield as it illustrated in (Figure 1) too.

Figure 3: Mean plot for seed type

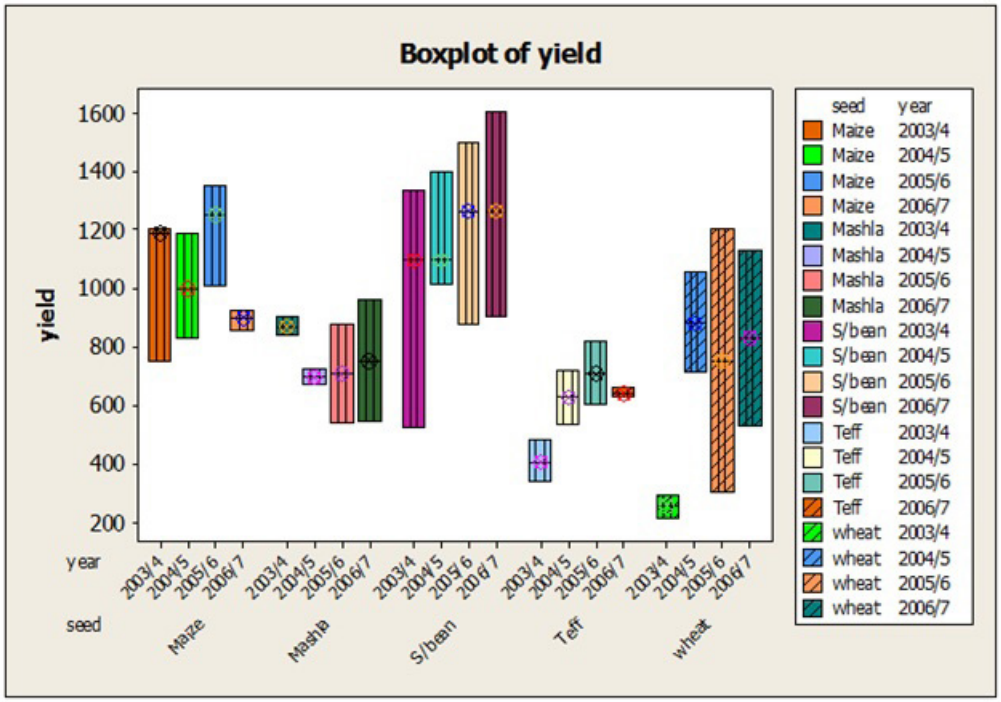


Figure 4: Box plot of yield corresponding to year and seed type (mashla=sorghum bicolor)

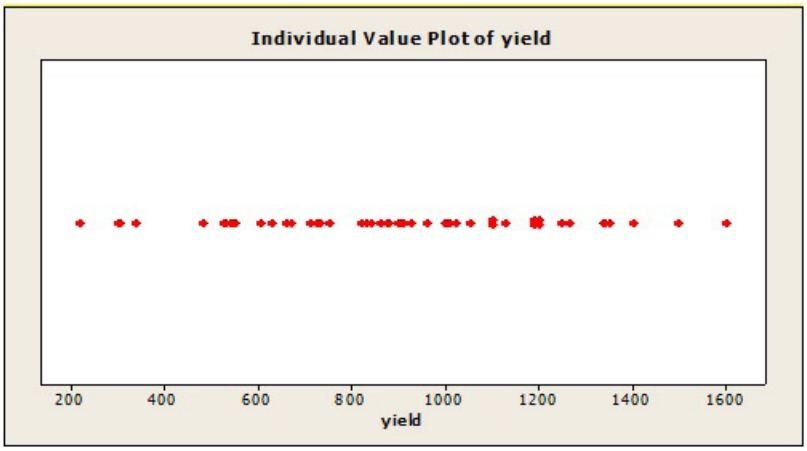


Figure 5: Dot plot for yield

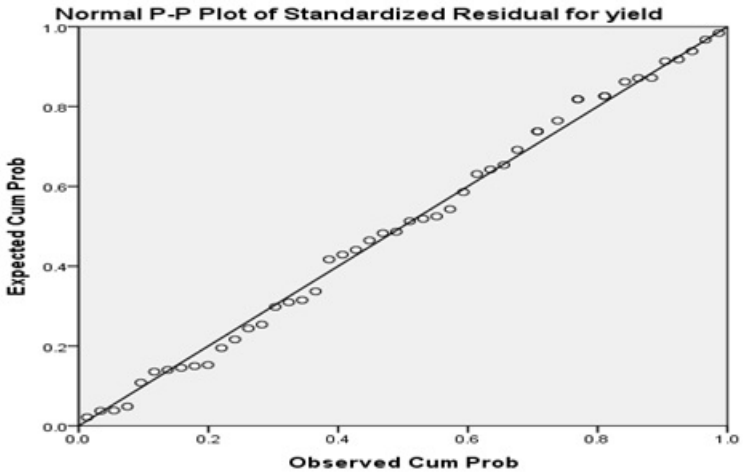


Figure 6: P-P plot for normality checking

4.2. Statistical Methods

Even if I try to describe different treatment in the descriptive part it is not adequate to say yes the treatment is really different or not. Let us give infere more about whether the factor has an interaction or main effect on the product of yield, (Table 2).

The ANOVA table tells us the model, the intercept, and seed type are 0.18, 0.00 and 0.00 p-values which is less than 0.05 that shows there is significant. While the p-value for year and the interaction term 0.082 and 0.686 which is greater than 0.05 which shows there is no a significant effect on the production of yield. Since seed is the only significant factor we need to give further analysis so that which seed type production of yield is differ can be identified.

Multiple comparison was done using Post hoc comparison tests. Once the significance difference between average production yield of seed type post hoc tests was carried out and pairwise comparison was made so that it can be identify which means differ. Comparisons are made on unadjusted values using Turkey test in (Table 3).

Table 1: General arrangement for a two factor- factorial design (seed type-A and year- B)
Where, Yijk= the kth observation of response variable under treatment "j"
in factor B and under treatment "i" in factor A. And where, k=1,2,3: j=1,2,3,4 and i=1,2,3,4,5.
The factor A and B that will perform in the study refers to:
The model for two factor factorial design is given by:

Factor	Levels
A-Seed Type	1. Maize
	2. Wheat
	3. Soyabean
	4. Teff
	5. Sorghum bicolor
B-Year (E.c)	1. 2003/2004
	2. 2004/2005
	3. 2005/2006
	4. 2006/2007

$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$

Where, μ= Overall mean

α_i = the Ith row effect of factor A

β_j= the Jth column effect of factor B

$(\alpha\beta)_{ij}$ = the interaction effect of factor A&B

ε_{ijk}= Random Error, need to be normally distributed with mean zero and constant variance.

Table 2: Descriptive Statistics of yield

Variable seed	Mean	Standard deviation	Minimum	Median	Maximum
Maize	1037.9	192.3	750	1005	1350
Sorghum bicolor	760	160.6	546	785	961
S/bean	1158.3	300.7	525	1182	1600
Teff	600	148.4	340	617.5	820
Wheat	682	402	220	623	1200

Table 3: ANOVA Table

Source	Sum of squares	Mean square	F	P-value
Model	3186509.667	167711.035	2.393	0.018
Year	281173.962	93724.654	1.338	0.282
Seed	2280972	570243	8.138	0
Year*Seed	637399.667	53116.639	0.758	0.686
Error	1962075	70074.107		
Total	43112446			

Table 4: Mean comparison using Tukey's test

(I)seed	(J)seed	Mean difference(I-J)	p-value	95% confidence interval	
				Lower bound	Upper bound
Maize	Sorghum bicolor	277.9167	.147	-57.6475	613.4808
	S/bean	-120.3333	.784	-420.471	179.8044
	Teff	437.9167*	.005	102.3525	773.4808
	Wheat	356.1667*	.033	20.6025	691.7308
	S/bean	-398.2500*	.013	-733.8141	-62.6859
Sorghum bicolor	Teff	160.0000	.729	-207.5921	527.5921
	Wheat	78.2500	.973	-289.3421	445.8421
	Teff	558.2500*	.000	222.6859	893.8141
S/bean	Wheat	476.5000*	.002	140.9359	812.0641
Teff	Wheat	-81.7500	.969	-449.3421	285.8421

The astrix from the mean difference shows there is significance mean difference between the two seed type on the other hand it also reflects from the p-value correspondingly which is less than 0.05. There is a significance average production of yield difference between Maize and Teff, Maize and Wheat, sorghum bicolor and S/bean, S/bean and Teff, and between S/bean and Wheat.

It can also detect from the confidence interval, if the confidence interval of the mean production of yield difference includes zero then there is no significance difference between the average productions of yield between the two seed type.

4.3. Model adequacy checking

The estimation that conducted using ANOVA need to be checked the assumption to be satisfied. The assumption, normality, was assessed using p-p plot in (Figure 6) below. The scatter plot closed the line with slope one indicates that normality assumption is satisfied.

5. Discussion and Conclusion

Ethiopian hybrid seed enterprise, Bahir Dar branch, one of the oldest enterprise that produce quality hybrid seeds for the farmers not only in Amhara region but also other neighbors. The enterprises have farmland that measure 80 hectare for each seed type. However, the enterprise members have getting difficulties to identify the amount of production of yield from each seed type within year 2003/4 to 2006/7. In order to answer these problem two factor factorial design/two-way ANOVA was used and mean comparison carried out using Turkey's test.

Production of maize have the highest production throught the specified year, which is in accordance with Maize is the most productive cereal in the country while wheat was the second [10, 1]. In 2009/10 wheat was surpassed by rice and sorghum, and its position was shifted to four the [4].

The year that the seed is planted is no any significant effect on the production of seed, of course it is actually reliable in Ethiopia standard, implies that there is no increment or decrement of yield due to year difference. While there is a significant effect of type of seed on the production of yield, from this soya bean and maize in case of maximum product on the other hand teff and wheat in case of minimum yield from the rest type of seed push for the contribution of rejection region even if other factors are controlled. In case of this there is less amount of product of teff even if it usually used for food in Ethiopia, specifically in the form of injera and wheat also mostly used for bread in the first hand and it has great role for different industrial product.

Maximum amount yield recorded in 2005/6 and 2006/7 implies there is an improvement of productivity (available use of inputs and get good product). Because the seed enterprise harvested a good product within this particular year of planting, it is advisable to detect all possible causes.

6. Recommendation

Actually quality seed is base for the development of country in agricultural centered country, we cannot transfer industrial center without mastering the agricultural center.

Arising from the findings I would like to recommend the following point for the enterprise.

- Soya bean and maize has the maximum productive seed among the rest seed, in case the enterprise should disseminate such hybrid seed for farmers.
- The enterprise need to give a critical awareness for the farmers in case of how to the seed planting by appropriate rearrangement of inputs.
- Sometimes some seed type may very less product harvested from the enterprise even if such seeds are most useful for the country. When such cases are exist the enterprise should be tried to improve the quality of hybrid seed heredity to harvest more amount of product. For instance from teff seed type the enterprise collect less amount of yield even if it is a back bone for the country for food.
- In the year 2005/6 there was maximum amount of yield harvested by the enterprise. In case of this I would like to encourage the enterprise to follow the trend of inputs combination in a year.

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