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THE EFFECTS OF VARIOUS SOIL TREATMENTS ON CROP YIELD IN SOUTHEASTERN NIGERIA

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Abstract: In this study, a PVC drip irrigation system was designed to investigate the effect of different soil treatments on crop yield, using Oba Super 13 maize variety as test crop, on three major plots, each representing a different tillage method. Each plot has three levels of each of the three soil treatments involved including irrigation deficit, tillage method and NPK Application rate, totaling 27 subplots. The three levels of irrigation treatments were 50%, 30% and 10% management allowable depletion levels; tillage treatments were conventional tillage, conservative tillage and no tillage methods, while the NPK application treatments were 400 kg/ha, 500 kg/ha and 600 kg/ha rates, and experimentally designed using the Central Composite Design (CCD) in Design Expert 11 software. The crop yield for all the subplots were determined, and maximum crop yield of 2540 kg/ha was obtained at conservative tillage with 10%MAD, and 600 kg/ha NPK application rate, while minimum tillage of 1234.67 kg/ha was obtained at no tillage, 50%MAD and 400 kg/ha NPK application rate.
Controllable variables were optimized using response surface methodology (RSM) with crop yield for all the subplots. The optimum values based on the run gave irrigation deficit as 11.594%, NPK Application rate as 596.406 kg/ha, best tillage method as conservative tillage, crop yield of 2543.589 kg/ha. The highest maize yield was obtained in conservative tillage and the results confirm the viability of obtaining high yield in the study area using drip irrigation system during the dry season.

Key words: *Irrigation, Management allowable depletion, Tillage, NPK Application rate*

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INTRODUCTION

Water availability for agriculture has been globally identified as one of the threats to crop production and food security according [1]. Presently, according to [2], only four percent of the total arable land in sub-Saharan Africa is irrigated, which implies that agriculture is predominantly rain-fed, thus, making the sector particularly vulnerable to the vagaries of climate variability and change. [3] Posits that agriculture remained the main source of livelihood and Gross Domestic Product in most African countries but faces threats from climate change and variability. Climate change and variability has generally posed critical challenges to sustainable development in South Eastern Nigeria, including agricultural activities and farming systems. [4] Described climate change as a situation when a change in climate condition continues in one direction, at rapid rate and for an unusual long period of time. It has also been defined by [2] as statistically significant variations that persist for an extended period, typically decades or longer and it includes shifts in the frequency and magnitude of sporadic weather events as well as the slow continuous rise in temperature. These changes occur due to variations in different climate parameters such as temperature and precipitation.

According to [5], climate change could manifest in a number of ways such as changes in average climate conditions where some regions become drier or wetter on average, and changes in climate variability where rainfall events become more erratic. Also, [6] observed that with increasing incidences of flooding, erosion, bush burning, pest and diseases, increased temperature, erratic rainfall and drought, it becomes pertinent that agricultural productivity under these circumstances will be very low. The low yield will distort the supply and demand pattern, commodity prices, profitability of farming and affordability of food and food security. It therefore becomes imperative to develop sustainable dry season farming in South-eastern Nigeria through irrigation that will supply the required amount of water needed in both quantity and quality, with drip irrigation being most favorable for water management purposes.

MATERIALS AND METHODS

Study Area

Field experiment was conducted at the Department of Agricultural and Bioresources Engineering Experimental Site/Farm Workshop, Nnamdi Azikiwe University, Awka, which lies between latitudes 6°15’11.8N to 6°15’5.3E and longitudes 7°7’118N to 7°7’183N and altitude of 142 m.

Previous studies identified the soil type of the area to be sandy loam, and typically of savanna covered with grass with geologic formation of Imo shale. The Anambra River and its tributaries are the major Rivers that drain the area, while there are two major climatic seasons, dry season (November to March) and rainy season (April to October) with reduced rain (August break) in August.

Dry season temperature ranges from 20°C to 38°C which increases evapotranspiration, while rainy season temperature ranges from 16 to 28°C, with lower evapotranspiration. The experiment was conducted between January 2022 to April 2022.

Materials and Equipment.

The materials used for the experiment included: 25mm, 19mm and 12.5mm PVC pipes for the main lines, the laterals and the sub mains, respectively, 19mm end cap, 25mm by 12.5 bend, 12.5mm by 19mm inch bend, 25mm ball gauge, 12.5mm ball gauge, 25mm by 12.5mm Tee, 12.5mm by 19mm Tee, 2mm drill machine. The equipment included: Design expert 11 software, Pressure gauge, Moisture meter, Storage tank, Block stand, Surveying instrument, Measuring cylinder, Tractor, Collection cans, Pressure plate apparatus.

Field Preparation

The field is a level ground and field preparation was done by dividing the plot into three major sections A, B and C, with each measuring 27m x 27m. Conventional tillage was done in the section A by thoroughly tilling with plough and harrow, conservative tillage was applied in section B by ploughing with one tractor pass, while section C received no tillage. The mapped out sections were levelled to obtain a level ground.

Field Layout

The experiment was laid out using central composite design (CCD), with experimental field consisting of 3 plots with 9 sub plots in each plot. The experimental design was performed as follows: Tillage methods (conventional tillage, where the area was tilled thoroughly with plough and harrow; conservative tillage, where tillage was done with plough and one tractor pass, while zero tillage received no tillage); Irrigation deficit levels (50% MAD, 30% MAD and 10% MAD) and NPK fertilizer application rates (450 kg/ha, 550 kg/ha and 650 kg/ha). The experimental plot was divided into 27 sub-plots with each sub-plot measuring 3m x 3m. PVC pipes of 25mm, 19mm and 12.5mm were used as the main line, sub-main and laterals respectively, with the laterals spaced 0.5m intervals, while holes were perforated on the laterals at 0.45m spacing to serve as emitter, with this, crop spacing was 0.5m x 0.45m. All other necessary operations such as pest and weed controls were performed according to general local practices and recommendations.

The Test Crop

The crop used for the experiment was OBA SUPER 13 *Zea mays L.* hybrid, and Table 1. shows the duration and growth stages.

Table 1. Duration and Period Within the Various Growth Stages

Growth stages	Duration(days)	Period
Initial stage	14	January 27 to February 10
Crop development stage	24	February 11 to March 6
Mild stage	27	March 7 to April 3
Late stage	20	April 4 to April 24

Drip Irrigation System

The 25 mm PVC pipes were used as main line, connected from the overhead tank, to the field layout, where they were connected to the sub mains through 19 mm x 25 mm tees. The laterals were connected to the sub mains through 19mm by 12.5mm tees, including all necessary accessories. The field capacity was determined at a pressure of 0.01 MPa while the permanent wilting point (PWP) of the soils was also determined at 1.5 MPa using the pressure plate apparatus.

Yield Components

For cobs plant per cob (Cob^{-1}), five plants were selected randomly from each plot and the number of maize ears in each plant was counted. Ears that have less than 5% of the kernels of normal ears were discarded. To obtain the grain per cob (Cob^{-1}), three ears were selected from each subplot at random and number of kernels in each ear was counted. The 1000- grain mass is a measure of the grain size weight in grams for 1000 seeds. Maize ears were selected at random from each subplot and one thousand grains counted from each subplot and weighed. Cob mass were determined as average weight values from randomly selected cobs from each subplot while the cob thickness was determined from cobs selected at random from each subplot and the thickness recorded, and average for each subplot determined. The grain yield was determined from the yield components.

Experimental Design and Optimization Parameters

Response Surface Methodology (RSM) was used to investigate the influence of irrigation deficit, NPK fertilizer application and tillage on crop yield. The central composite design and their values are shown in Table 2. For this research, the factors irrigation deficit (%), NPK Application rate (kg/ha) and Tillage were represented with A, B and C respectively.

Table 2. Independent variables and levels used for response surface design

Independent variables	Symbols	Ranges and levels			
			-1	0	+1
Irrigation Deficit (%)	A		10	30	50
NPK Application rate (kg/ha)	B		400	500	600
Tillage	C		1	2	3

For statistical analysis, the experimental data obtained from central Composite design were analyzed by Response Surface Methodology (RSM), while a mathematical model, following a second order polynomial which includes interaction terms was used to calculate the predicted responses.

RESULTS AND DISCUSSION

Field Capacity

The result showed that the field capacity was minimum at no tillage (0.07cm^3/cm^3, 0.11cm^3/cm^3, 0.12cm^3/cm^3, and 0.14cm^3/cm^3) for soil depths 0-25cm, 25-50cm, 50-75cm and 75-100cm respectively, and for conservative tillage (0.11cm^3/cm^3, 0.11cm^3/cm^3, 0.11cm^3/cm^3, 0.14cm^3/cm^3) for 0-25cm, 25-50cm, 50-75cm and 75-100cm soil depths respectively, while conventional tillage recorded (0.09cm^3/cm^3, 0.13cm^3/cm^3, 0.15cm^3/cm^3, 0.17cm^3/cm^3) for 0-25cm, 25-50cm, 50-75cm and 75-100cm soil depths respectively. At 0-25cm soil depth, there was a bigger value of field capacity in conservative tillage than conventional tillage, and this could be because of runoff which occurred in the top soil in conventional tillage as there was maximum disturbance of soil, which disagreed with the observation reported by (7). This is because the soil type is clay loam where highest FC was observed in no tillage (0.14cm^3/cm^3), followed by conservative tillage (0.08cm^3/cm^3). Also from the results, increase in soil depth increased field capacity which is in agreement with (8), where field capacity increased from 0.24cm^3/cm^3 to 0.3cm^3/cm^3.

Permanent Wilting Point (PWP)

From the result, permanent wilting point increased with increase in soil depth in conventional tillage and no tillage with PWP of 0.01cm^3/cm^3, 0.05cm^3/cm^3, 0.09cm^3/cm^3 and 0.11cm^3/cm^3 at 0-25cm, 25-50cm, 50-75cm and 75-100cm soil depths respectively for conventional tillage and PWP of 0.02cm^3/cm^3, 0.05cm^{3}cm^3, 0.05cm^3/cm^3 and 0.08cm^3/cm^3 at 0-25cm, 25-20cm, 50-75cm and 75-100cm soil depths respectively for no-tillage. This is in agreement with (8), which recorded an increase in permanent wilting point with increase in soil depth of 0.10cm^3/cm^3 to 0.15cm^3/cm^3. For conservative tillage pwp of 0.05cm^3/cm^3, 0.04cm^3/cm^3, 0.09cm^3/cm^3, and 0.07cm^3/cm^3 were recorded for 0-25cm, 25-50cm, 50-75cm and 75-100cm soil depths respectively. There was variation in permanent wilting point for conservative tillage which could be as a result of the bulk density of the soil.

Grain Cob^{-1}

This is the number of grains contained in a corn cob and the values for different treatments are presented in Table 3.

Table 3. Grain Cob^{-1}

kg/ha NPK	Conventional Tillage	Conservative Tillage	No Tillage
10% MAD/600	504	594g	467g
10% MAD/500	503	591g	467g
10% MAD/400	501	577g	461g
	Conventional Tillage	Conservative Tillage	No Tillage

Contin. Tab.3			
30% MAD/600	495	509	433
30% MAD/500	416	495	401
30% MAD/400	396	439	371
Contin. Table 3.			
	Conventional Tillage	Conservative Tillage	No Tillage
50% MAD/600	453	471	409
50% MAD/500	433	450	391
50% MAD/400	390	410	351

From the result of grain Cob^{-1} in Table 3., highest grain cob^{-} of 594 was obtained in conservative tillage at 10% MAD and 600 kg/ha NPK, while the lowest was obtained at No tillage, 50% MAD and 400 kg/ha NPK application. The average grain per cob obtained were 454.5, 515.1, and 416.7 for conventional tillage, conservative tillage and no tillage respectively. This is not in agreement with (9), where highest number of grain Cob^{-} of 528 was obtained in conventional tillage, while the lowest number of grain cob^{-} of 319 was obtained on no tillage. The difference in result could be as a result of soil type, infiltration rate and permeability.

1000 Grain Mass

This is the mass of 1000 grains in grams for the different treatment methods and the values are presented in Table 3.1.

Table 3.1. Result for 1000 Grain mass

kg/ha NPK	Conventional Tillage	Conservative Tillage	No Tillage
10% MAD/600	324g	342g	245g
10% MAD/500	280g	288g	190g
10% MAD/400	263.1g	271g	151.1g
	Conventional Tillage	Conservative Tillage	No Tillage
30% MAD/600	316g	316g	231g
30% MAD/500	296g	299g	219g
30% MAD/400	275g	279g	197g
	Conventional Tillage	Conservative Tillage	No Tillage
50% MAD/600	301g	295g	219g
50% MAD/500	290g	291g	196g
50% MAD/400	279g	279g	190g

From the result of 1000 grain mass in Table 3.1., the same trend as in grain cob^{-} was observed, with the highest 1000 grain mass recorded in conservative tillage/10%MAD/600 kg/ha, while the lowest was in no tillage/50%MAD/400 kg/ha.

For conventional tillage, conservative tillage and no tillage, average 1000 grain weight of 291.5g, 295.5g and 158g respectively were obtained.

This also disagrees with (9), where highest 1000 grain mass of 265g at conventional tillage and lowest value of 204g at no tillage were obtained, and this variance in results could be attributed to the difference in soil types of the study areas.

Cob Mass

The cob weight is the weight of each corn cob in gram for all the treatments, and the values are tabulated in Table 3.2.

Table 3.2. Result for Cob Mass

kg/ha NPK	Conventional Tillage	Conservative Tillage	No Tillage
10% MAD/600	406g	406g	370g
10% MAD/ 500	397g	399g	370g
10% MAD/ 400	370g	391g	354g
	Conventional Tillage	Conservative Tillage	No Tillage
30% MAD/600	401g	405g	367g
30% MAD/500	397g	397g	361g
30% MAD/400	379g	390g	360g
	Conventional Tillage	Conservative Tillage	No Tillage
50% MAD/600	400g	405g	359g
50% MAD/500	395g	403g	351g
50% MAD/600	390g	395g	347g

The results of the cob mass shown in Table 3.2., recorded average cob mass values of 392.g, 399g and 283.3g for conventional tillage, conservative tillage and no tillage respectively, with the highest cob mass of 406g obtained in conventional and conservative tillage/10%MAD600 kg/ha. The lowest cob weight of 347g was also obtained in no tillage/50%MAD600 kg/ha. This is in agreement with (8), where maximum cob mas of 455g was obtained for conventional tillage, followed by cob weight of 408 for reduced tillage and lowest cob weight of 234g for no tillage.

Grain Yield

The grain yield is the crop yield for the treatments and the values are presented in Table 3.3.

Table 3.3. Result for Crop Yield

kg/ha NPK	No Tillage (kg/ha)	Conservative Tillage (kg/ha)	Conventional Tillage (kg/ha)
10% MAD/600	1401.73	2540.09	2195.03
10% MAD/500	1390.36	2505.19	2059.64
10% MAD/400	1334.9	2345.24	1643.89
	Conventional Tillage	Conservative Tillage	No Tillage
30% MAD/600	1354.16	2475.1	1976.09
30% MAD/500	1323.7	2401.09	1904.57
30% MAD/400	1301.23	2395.19	1701.67
	Conventional Tillage (kg/ha)	Conservative Tillage (kg/ha)	No Tillage (kg/ha)
50% MAD/600	1301.34	2309.9	1860.49
50% MAD/500	1291.67	2345.24	1791.19
50% MAD/400	1234.67	2301.06	1506.91

Table 3.3., shows that the highest crop yield of 2540 kg/ha was obtained in conservative tillage/10%MAD/600 kg/ha, while lowest crop yield of 1234.67 kg/ha, was obtained in no tillage/50%MAD/400 kg/ha, while, average grain yields of 1848.8 kg/ha, 2135.8 kg/ha, and 1325.9 kg/ha, were obtained for conventional tillage, conservative tillage and no tillage respectively. This result is in agreement with [9], where they compared maize yield in conventional and conservative tillage and obtained maximum crop yield of 6221.08 kg/ha, for conservative tillage and lowest crop yield of 5372.0 kg/ha for conventional tillage. In contrast [8], obtained highest crop yield of 7.34 ton ha^{-1} in sub-soiling and lowest crop yield of 6.70 ton ha^{-1} in zero tillage.

Development of Regression Model

Central Composite Design (CCD) was used to optimize properties. The statistical combination of the independent variables along with the experimental response are presented in Table 4. To develop a statistically significant regression model, the significance of the coefficient was evaluated based on the p-values. The coefficient terms with the p-value more than 0.05 are insignificant because the p value of ≤ 0.005 was used.

Table 4. Design Summary

Factor Name	Units	Type	Min	Max	Coded Low	Coded High	Mean	Std. Dev.
A Irrigation Deficit	%	Numeric	10.00	50.00	-1 ↔ 10.00	+1 ↔ 50.00	30.00	16.64
B NPK App.	kg/hA	Numeric	400.0	600.0	-1 ↔ 400.00	+1 ↔ 600.00	500.00	83.21
C Tillage		Categoric	1	3	Levels:3			

Response	Name	Units	Observat.	Analysis	Min/ Max	Mean/ Std. dev.	Ratio	Transf.	Model
R1	Crop Yield	kg/ha	27	Polynomial	1234.67 2540.09	1858.94 466.62	2.06	None	Reduc Cubic

The values presented in Table 4., were used for the design of the experiment. The factors are Irrigation deficit %, NPK Application Rate (kg/ha) and Tillage, while the response is Crop Yield (kg/ha). Irrigation deficit, which is a numeric factor with minimum range of 10% and maximum of 50% has a mean of 30% and standard deviation of 16.64. The NPK Application rate, which is also a numeric factor with a minimum value of 400 kg/ha, and maximum of 600 kg/ha has a mean of 500 kg/ha standard deviation of 83.21. Tillage is a categorical factor with three levels, namely, no tillage, conservative tillage and conventional tillage. The response which is crop yield has maximum value as 2540.09 and minimum as 1234.67, with a mean of 1858.94 and standard deviation of 466.62.

Statistical Analysis for Crop yield

The sequential model sum of squares for crop yield is presented in Table 5.

Table 5. Sequential Model Sum of Squares for Crop yield

Source	Sum of Squares	Df	Mean Square	F-value	p-value	
Mean vs Total	9.330E+07	1	9.330E+07			
Linear vs Mean	5.483E+06	4	1.371E+06	169.81	<0.0001	
2FI vs Linear	1.291E+05	5	25817.90	9.05	0.0002	Suggested
Quadratic vs 2FI	15019.15	2	7509.58	3.36	0.0621	
Cubic vs Quadratic	22533.64	8	2816.71	1.80	0.2268	Aliased
Residual	10961.18	7	1565.88			
Total	9.896E+07	27	3.665E+06			

From the sequential model (linear, two factor interactions 2FI, Quadratic and Cubic polynomial), on Table 5., the 2FI and linear model was selected by Design Expert 11.1.2.0 version due to its highest order polynomial.

Table 6. Analysis of Variance (ANOVA) for the Fitted Quadratic Model for Crop yield

Source of variables	Sum of Squares	df	Mean Square	F-value	p-value	
Model	5.645E+06	17	3.320E+05	182.70	< 0.0001	Significant
A-Irrigation deficit%	1.206E+05	1	1.206E+05	66.38	< 0.0001	
B-NPK Application rate	1.511E+05	1	1.511E+05	83.14	< 0.0001	
C-Tillage	5.212E+06	2	2.606E+06	1433.80	< 0.0001	
AB	12270.73	1	12270.73	6.75	0.0288	
AC	16990.60	2	8495.30	4.67	0.0405	
BC	99828.17	2	49914.08	27.46	0.0001	
A^2	1746.03	1	1746.03	0.9607	0.3526	
B^2	13273.12	1	13273.12	7.30	0.0243	
ABC	6136.70	2	3068.35	1.69	0.2385	
A^2C	1031.88	2	515.94	0.2839	0.7594	
B^2C	9969.09	2	4984.55	2.74	0.1175	
Residual	16357.15	9	1817.46			
Cor Total	5.661E+06	26				

Std.Dev.	42.63	R^2	0.9971
Mean	1858.94	Adjusted R^2	0.9917
C.V. %	2.29	Predicted R^2	0.9690
		Adeq Precision	37.6191

The analysis of variance (ANOVA) was carried out to determine the significance of the fitness of the selected Quadratic Model as well as the significance of individual terms and their interaction on the chosen responses.

From Table 6., the regressors incorporated in the model F-value of 182.70 with P-value of <0.0001 implies that the model is significant at 95% confidence level.

The P-value (probability of error value) is used to check the significance of each regression coefficient and the interaction effect of each cross product. In the case of the model terms, the p-value less than 0.05 shows that the model terms are significant, in this case A, B, C, AB, AC, BC, and B^2, are significant model terms.

The model as fitted presents an R- square of 0.9971 and standard deviation of 42.63. The three factors (Irrigation deficit, NPK Application rate, and Tillage) were found to be statistically important (significant) at confidence level of 95%. A low value of Coefficient of variation (0.073%), showed a high degree of precision and reliability of the values.

The predicted values versus actual value for the Crop yield with R^2 value of 0.9917 shows a model with 99.17% of variability as shown on Figure 1. The Predicted R-Squared of 0.9690 is in reasonable agreement with the Adjusted R-Squared of 0.9917; with the difference being less than 0.2 and their R^2 values close to unity. This indicates that the data fits with the model.

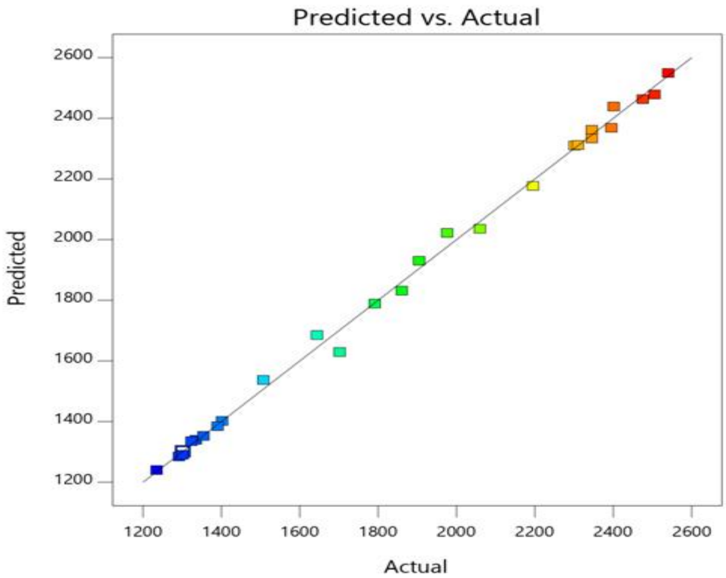

Figure 1. Diagnostics Plots of the fitted Quadratic Model for Crop yield

Investigation on residuals to validate the adequacy of the model used was performed; residual is the difference between the observed response and predicted response. The plot of actual versus predicted on Figure 1., shows that there is a very good correlation between the observed value and the values predicted by the model, and the model does not show any variation of the constant variance.

Model Equation for Crop yield

Model equation for crop yield (No Tillage) is as equation 1

$$905.86125 - 2.39650A + 1.70182B - 0.000020\,A * B - 0.001463A^2 - 0.001391B^2 \quad \ldots(1)$$

For the crop yield, conservation tillage, the model equation is given as equation 3.2

$$1320.33514 + 12.90729A + 3.44454B - 0.023251A * B - 0.081683A^2 - 0.002274B^2 \quad \ldots(2)$$

Equation 3.3 gives the model for crop yield (Conventional Tillage) as

$$1889.28653 + 8.86883A + 13.15142B - 0.024695A * B - 0.044796A^2 - 0.010445B^2 \quad \ldots(3)$$

Eliminating the non-significant terms for the different tillage methods, the equations reduce to equations 4, 5 and 6 respectively.

The model equation for crop yield (No Tillage) thus, becomes:

$$905.86125 - 2.39650A + 1.70182B - 0.000020\,A * B + 0.001391B^2 \quad \ldots.(4)$$

For the conservative tillage method, equation 2 yields:

$$1320.33514 + 12.90729A + 3.44454B - 0.023251A * B + 0.002274B^2 \quad \ldots(5)$$

Equation 3 yields equation 6 depicting the equation for conventional tillage method as:

$$1889.28653 + 8.86883A + 13.15142B - 0.024695A * B + 0.010445B^2 \quad \ldots.(6)$$

These equations can be used to make predictions about the response for given levels of each factor.

Statistical 3D plots for Crop yield

From the 3D plots of crop yield in Figures 2, 3, 4., increasing irrigation deficit and NPK application reduces crop yield, this is because high crop yield occurs when there is adequate supply of water, that is, when soil moisture is not depleted beyond reasonable moisture range.

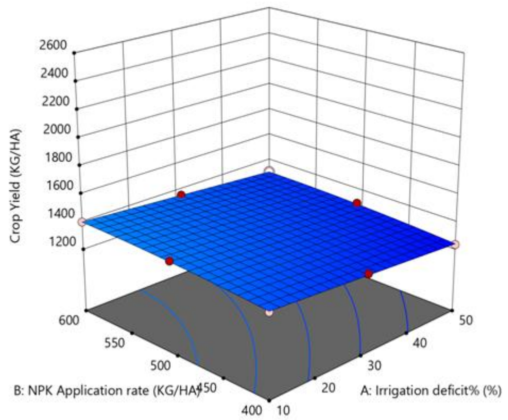

Figure 2. Statistical 3D plots for Crop yield (No Tillage)

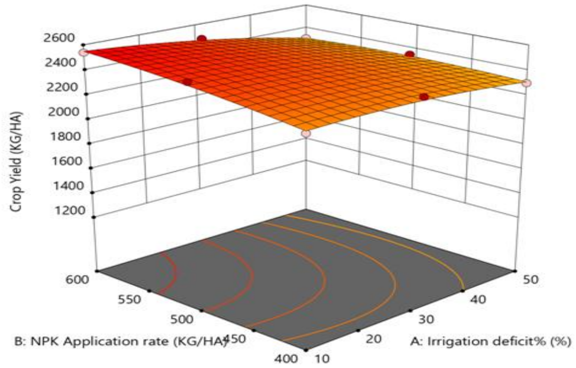

Figure 3. Statistical 3D plots for Crop Yield (Conservative Tillage)

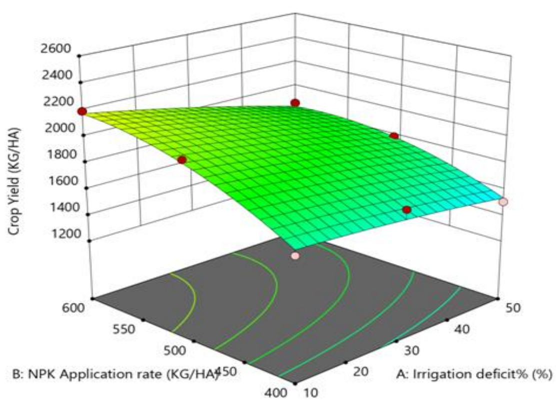

Figure 4. Statistical 3D Plots for Crop Yield (Conventional Tillage)

Table 7. Optimization Solutions

Number	Irrigation deficit%	NPK Application rate kg/ha	Tillage	Crop Yield	Desirability	
1	11.594	596.406	2	2543.589	1.000	Selected
2	10.154	599.069	2	2548.833	1.000	
3	12.194	599.053	2	2543.018	1.000	
4	11.048	597.860	2	2545.808	1.000	
5	10.428	595.845	2	2546.531	1.000	

The responses of the variables in Table 7. were generated by Design Expert 11.0 software for optimization based on the model obtained and the experimental data input. From Table 7., the run 1 order gave the optimum condition and was selected.

The optimum values based on the run order 1 gave irrigation deficit as 11.594%, NPK application rate as 596.406 kg/ha, best tillage method as conservative tillage, and crop yield of 2543.589 kg/ha.

CONCLUSION

The study showed that it was possible to produce good crop yield from drip irrigation in the study area during the dry season in the Southeastern Nigeria. The crop yield determined from the experiment shows that there was greater crop yield in conservative tillage than conventional and no tillage conditions, this is because of minimum disturbance of the soil that did not further reduce soil quality. Increase in NPK application and decrease in irrigation deficit increased crop yield in all the tillage practices.

The Central Composite Design (CCD) optimization model was used for finding the best levels of the process factors.

The model shows that for Irrigation deficit of 11.594%, at NPK Application rate of 596.406 kg/ha, and conservative tillage, the optimum response values obtained is Crop yield of 2.543.589 kg/ha (kg ha^{-1})

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EFEKTI RAZLIČITIH TRETMANA ZEMLJIŠTA NA PRINOS USEVA U JUGOISTOČNOJ NIGERIJI

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Apstrakt: U ovoj studiji, PVC sistem za navodnjavanje kap po kap je dizajniran zbog istraživanja uticaja različitih tretmana zemljišta na prinos useva, koristeći kao test usev određenu sortu kukuruza Oba Super 13.

Ogled je postavljen na tri osnovne parcele, od kojih svaka ima drugačiji metod obrade zemljišta i različita tretiranja useva kukuruza. Svaka parcela ima tri nivoa svakog od tri ispitivana tretmana zemljišta: deficit navodnjavanja, metodu obrade zemljišta i procenat primene đubriva NPK, što znači ima ukupno 27 različitih načina tretiranja useva .

Tri tretmana upravljanja sa navodnjavanjem kod 50%, 30% i 10% dozvoljene potrošnje vode. Tipovi obrade zemljišta su: konvencionalna, konzervacijska i tretman bez obrade zemljišta.

Primene NPK bile su: 400 kg/ha, 500 kg/ha, i 600 kg/ha (kg ha^{-1}).

Za eksperimentalno dizajniranje ovog ogleda upotrebljen je Central Composite Design (CCD) sa programom Design Expert 11.

Utvrđen je prinos za sve podparcele, gde je maksimalni prinos useva od 2540 kg/ha dobijen pri konzervacijskoj obradi sa tretmanom 10%MAD i 600 kg/ha NPK.

Minimalna obrada zemljišta imala je prinos 1234,67 kg/ha, bez obrade zemljišta, 50%MAD i primenjenom dozom od 400 kg/ha NPK.

Kontrolisani promenljivi parametri ogleda su optimizovani korišćenjem metodologije kontrolne površine (RSM) sa prinosom useva za sve podparcele.

Optimalne vrednosti na osnovu ciklusa pokazuje deficit navodnjavanja od 11,594%, dozu primene NPK 596,406 kg/ha, dok je najbolja metoda obrade konzervacijska obrada zemljišta sa prinosom useva 2.543,589 kg/ha.

Najveći prinos kukuruza je dobijen sa konzervacijskim načinom obrade zemljišta i rezultati potvrđuju održivost dobijanja visokog prinosa na ispitivanom području korišćenjem sistema za navodnjavanje kap po kap tokom sušne sezone.

Ključne reči: *Navodnjavanje, upravljanje dozvoljenom potrošnjom, obrada zemljišta, doza primena NPK.*

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