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PERFORMANCE OF IRISH POTATO (*SOLANUM TUBEROSUM* L.) AS AFFECTED BY NPK FERTILIZER AND POULTRY MANURE RATES IN MUBI, NORTHERN SUDAN SAVANNAH, NIGERIA

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ABSTRACT

An experiment was conducted at the student demonstration farm of the Department of Agriculture, Federal Polytechnic, Mubi to evaluate the "Performance of Irish potato as Affected by NPK Fertilizer and Poultry Manure Rates in Mubi, Northern Sudan Savannah, Nigeria" during the 2024 rainy season. The treatment consisted of 4 rates of Poultry manure: (9.5 t ha^{-1}, 7.5 t ha^{-1}, 5.5 t ha^{-1}, and 3.5 t ha^{-1}) and 4 rates of NPK fertilizer: (0 kg NPK ha^{-1}, 50 kg NPK ha^{-1}, 75 kg NPK ha^{-1} and 100 kg NPK ha^{-1}) The experiment was conducted in a Split-Plot Design, replicated 3 times. Data were collected on days to seedling emergence, days to 1st flowering, days to tuber maturity, average tuber weight, tubers yield plot (kg) and tuber yield ha^{-1}. Data obtained were subjected to analysis of variance ANOVA using Statistical Package for Scientist and Engineer (SPES), 2012. Significant means were separated using Duncan Multiple Range Test (DMRT).The result of growth performance showed that; there were significant difference in the poultry manure application with days to seedling emergence and number of branches at 9 weeks ($P<0.05$), plant height at 6 weeks , number of leaves at 3 and 9 weeks ($P<0.01$). However, plant height at 3 weeks, number of leaves at 6 weeks and number of branches at 3 and 6 weeks were not affected. Result of NPK rates application showed that days to seedling emergence, plant height at 6 weeks, number of leaves at 9 weeks, number of branches at 6 and 9 weeks were significantly ($P<0.001$) different among the various rates of NPK fertilizer application. Result of yield and yield components revealed that, days to 1st flower and number of tubers per plot were ($P<0.01$) and yield per hectare ($P<0.05$) was significantly affected by the rates of poultry manure application However, days to tuber maturity and average tuber weight were not significantly different. Result of NPK rate application showed that days to 1st flower and average tuber weight ($P<0.05$), number of tubers per plot and tuber yield per hectare ($P<0.001$) were significantly affected by the different rate of NPK application. However, days to tuber maturity was not statistically different. The interaction effects depicted that plant height, number of leaves at 6 and 9 weeks, number of branches at 9 weeks, number of tubers per plant, tuber yield per plot and tuber yield per hectare were either significantly different at $P<0.01$ or $P<0.001$. It could be concluded and recommended that, poultry manure rate at 7.5 t PM ha^{-1}, NPK fertilizer rate at 75 kg NPK ha^{-1} and combination of rate of P_2N_2 having given the best results in the growth performance and yield parameters of Irish Potatoes be recommended for use in Mubi environment.

Keywords: Nitrogen, Irish Potato, Poultry Manure, Performance, Growth and Yield

INTRODUCTION

The role of major root and tuber crops such as yam, cocoyam, cassava, sweet potato, and Irish potato in the human diet of sub-Saharan Africans cannot be overemphasized. Irish Potato (*Solanum tuberosum* L.), is an annual flowering plant belongs to the *Solanaceae* family (Reddy, 2018) It is the most fruitful and efficient tuber crop in the world with regard to tuber yield maturity period. This tuber crop matures within 2 – 3 monthe as compared to yam and cassava which takes 9 – 12

months Kudi, *et al*., 2008; Muthani, *et al*., 2021). It is the most important favorite vegetable crop grown in more than 100 countries of the world as food with a high unrealized potential to improve food security, income and human nutrition to many households (Schulte-Geldermann, 2013). It is widely cultivated for its cheap source of carbohydrates, vitamins B_1 & C as well as minerals (Rashid, 2013). This valuable tuber crop provides essential nutrients and energy for human consumption but require intensive management (Halterman *et al.,* 2016). Irish potatoes are so much rich in nutrient contents such as vitamin C, potassium, fibre and antioxidant. They contribute to lots of healthy diets and may help to reduce the incidence of various diseases, like cardiovascular disorders and hypertension (Beals, 2019; Gupta and Gupta, 2019).

Fertilizer application has an important effect on the yield and quality of Irish. Errebhi, *et al.,* (1998) stated that Irish is highly responded to fertilizer and it is usually the most specific essential nutrient for its growth on all soil types especially sandy soil. Nkoa, *et al.,* (2002) revealed that using mineral fertilizer (N, P, and K) increased leafy vegetable growth, yield and its quality. It is believed that, high yield and good quality of Irish can be achieved by efficient use of fertilizer. The application of chemical fertilizers along may not be sufficient under intensive crop management system and result in an overall reduction in the final output (Hepperly, *et al.,* 2009) and consequently significant problems such as soil degradation and soil pollution causes by high application rates of chemical fertilizer (Singh, 2000). However, the use of manure from animal origins such as poultry manures is another alternative source of nitrogen and other essential nutrients, which can decease the demand of chemical fertilizer and it has been used for decades to improve soil fertility. Except for the supply of nitrogen fraction, poultry manure can boost the chemical, physical and biological characteristics of soil (Benke, *et al.,* 2008). The amount of nutrient in poultry manure is almost equal to the amount of nutrients in mineral fertilizers, it is therefore critical to be applying at the right quantity (Thomas *et al* 2019).

Although, there is no scientific evidence to ascertain the cultivation of Irish potato in Nigeria apart from Jos, Plateau and Mambila in Taraba state. However, farmers in Mubi South local government area of Adamawa state, especially Kwoja province, have since been cultivating this valuable crop. The climate of Mubi and its environs resembled that of Jos which might have supported the growth of certain quantity of Irish in the region. The knowledge of Cultural practices, cultivar, manure/fertilizer type/rates and the methods of pest and disease control measure used are only known to them. Therefore, this study intends to examine the performance of Irish potato as affected by NPK fertilizer and Poultry manure application rates in Mubi, Northern Sudan Savannah, Nigeria in order prove its production in the area, create awareness worldwide and also for the betterment/welfare of farmers in the area and the country at large.

MATERIALS AND METHODS

The Experimental Site

The field experiment was conducted at the Student's Research Farm of the Department of Agricultural Technology, Federal Polytechnic, Mubi. The site is situated between latitudes 9^0 26" and 10^0 10"N on longitudes 13^0 10" and 13^0 44"E at an altitude of 696 m above mean sea level under rain fed conditions. The soil is largely of sandy, clay–loam, sandy–loam or loam textured. The annual mean rainfall in Mubi was 900 mm and the minimum temperature of 18 ^{0}C during the harmattan period and 40 ^{0}C maximum in April (Adebayo *et al*. (2020). Muhammad, *et al*., (2017) identified 2 types of seasons, viz; the wet season which lasted from April – October and dry season covered November – March characterized by cold dry dust laden wind especially in January and February.

Treatment and Experimental Design

The treatments comprised the application of 4 rates of Poultry manure: (9.5 t ha^{-1}, 7.5 t ha^{-1}, 5.5 t ha^{-1}, and 3.5 t ha^{-1}) and 4 rates of NPK fertilizer (100 kg ha^{-1}, 75 kg ha^{-1}, 50 kg ha^{-1} and 0 kg ha^{-1}) factorially combined and arranged in Split-Plot Design, replicated 3 times.

Planting Materials:
Irish potato seeds (tubers) obtained from a certified local seed vendor from Jos, Plateau state. The young tubers were spread on clean river sand in chemical Science laboratory I, of the Department of Chemical Science Technology of the Institution to enable tubers develop more buds for easy selection. Rotten once were discarded and viable once used for planted. NPK fertilizer 15:15:15: purchased from Mubi main market. Seeds were treated with Apron Star WS (*Thia-methoxan + difenocanazole*) at the rate of 1 sachet (10 g) per 5 kg potato tubers prior to planting in the field.

Experimental Procedures and Crop Management
The experimental site were manually cleared; shrubs, debris and left over plants residues from the previous harvest present on the field were collected by one site of the farm and burn. Herbicide; (Glyphosate and Diron) as well as insecticide (INCA) i.e. 'anti mirides' **(***Alphacypermethrin, Chloview*) were applied to control weeds and soil borne diseases. Later the field were harrowed by tractor to create good tilt soil conditions for easy roots penetration/ development and tubers production and then ridges formed. The field were divided in to 3 blocks and each block consisted of 16 plots given the total of 48 plots. A path way of 1 m both between plots and replications to allow for easy movement during data collection created. The total land area for the experiment measured 677.15 m^2 with gross plot size measured 3 × 2.45 m (7.35 m^2) and the net plot size of 2.4 × 2 m (4.8 m^2). There were 4 ridges in each plot, each ridge had 6 plant stands given the total number of 24 stands in each plot. One (1) seed planted per stand at the depth of 5 – 6 cm at the spacing interval of 60 × 35 cm row and intra raw spacing respectively. During plot construction, poultry manure were applied as a treatment to each plot in accordance research design and allowed for 1 weeks to undergo chemical decomposition. The 2nd treatment 'Nitrogen was applied in split doses. Viable potato seeds (smaller potatoes) were planted manually by placing in a moist soil condition at the rate of 1 seed/stand, 4 - 5 cm depth. The seeds were placed at the distance of 60 x 35 cm both inter and intra row spacing systematically. Matured potato tubers harvested manually by digging under the plant's roots with a shovel and spading fork.

Weeding and Earthing
Weeds were manually control with the aid of hoe at 3, 6, 9 and 12 WAP. At the same time, "Earthing" which is the raising of loose soil from the inter rows spacing and replacing on the ridge along the rows were done at each weeding and emphasized when the crop started tubering in order to protect developing tubers from exposure of sunlight which might lead to pest/insects and disease attack like potato tuber moth.

Data collection
Growth and yield parameters determined includes: day's to seedling emergence, plant height, number of leaves, numbers of branches, day's to first flower, day's to tuber maturity, average tuber weight, number of tubers per plant and tubers yield per hectare.

Data Analysis
The data collected were subjected to analysis of variance (ANOVA) using SPSE 2012, version 9.1 for windows significant means were separated by Duncan Multiple Range Test (Duncan, 1955) at 5% probability level.

RESULTS AND DISCUSSIONS
Mean Effects of Poultry Manure and NPK Fertilizer Application Rates on the Growth Performance of Irish Potatoes at 3, 6, & 9 Weeks.
The effect of different rate of poultry manure application on growth performance of Irish potatoes is shown in Table 2. The results showed that they were significant difference in the poultry manure application with days to seedling emergence and number of branches at 9 weeks ($P<0.05$), plant height at 6 weeks , number of leaves at 3 and 9 weeks ($P<0.01$). However, plant height at 3 weeks,

number of leaves at 6 weeks and number of branches at 3 and 6 weeks were not affected. The significant mean values were 15.58 days, 20.27, 44.72cm, 13.75, 42.90, respectively. The significant mean was obtained with Irish potatoes supplied poultry manure at 7.5 tonnes/ha^{-1}. The results of days to seedlings emergence showed that the application of 3.5 tons of poultry manure per hectare resulted in the delayed seedlings emergence with a mean value of 15.58 days. While, application rate at 7.5 ton/ha^{-1} gave earliest seed emergency (14.03 days). This study is similar with the previous study of Amjad & Khan (2022), who reported that application of organic manure can promote early seedlings emergence in potatoes. Another study by Kabiri *et al*. (2015) reported that application of poultry manure at a rate of 5 tons per hectare significantly reduced the days to seedlings emergence in potatoes. However, in this study, the application of 7.5 tonnes of poultry manure per hectare resulted in the earliest seedlings emergence.

The application of 7.5 tonnes of poultry manure per hectare resulted in the tallest plants at 6 weeks, with a mean height of 44.72 cm. This could be due to the fact that poultry manure contains essential nutrients such as nitrogen, phosphorus, and potassium, which are necessary for plant growth and development (Girma & Tana, 2022). According to Zhang *et al*. (2020), the application of poultry manure can increase plant height by providing essential nutrients for plant growth and development. Additionally, the slow release of nutrients from poultry manure may have contributed to the increased plant height. As Ojaghloo *et al*. (2015) reported that, the slow release of nutrients from organic manure can provide a steady supply of nutrients to plants, leading to increased growth and development.

Application of 7.5 tonnes of poultry manure per hectare resulted in the highest number of leaves at three, six, and nine weeks. This could be due to the fact that poultry manure contains essential micronutrients such as iron, zinc, and boron, which are necessary for leaf growth and development (Xu *et al.,* 2025). According to Ali & Muhammad (2022), reported that, application of poultry manure can increase the number of leaves by providing essential micronutrients for leaf growth and development. Additionally, the improved soil structure and water-holding capacity resulting from the application of poultry manure may have contributed to the increased number of leaves. As Zhang *et al*. (2020) found that, application of organic manure can improve soil structure and water-holding capacity, leading to increased plant growth and development. The highest number of branches at nine weeks, with a mean value of 20.27 branches was at 7.5 tonnes/hac. This could be due to the fact that poultry manure contains essential nutrients such as nitrogen, phosphorus, and potassium, which are necessary for branch growth and development. Ahmed & Alam (2018) discovered that application of organic manure can improve soil fertility and structure, leading to increased plant growth and development. According to Ojaghloo *et al.* (2015), the application of poultry manure can increase the number of branches by providing essential nutrients for branch growth and development.

The same Table 2 shows different rate of NPK fertilizer application rate. The result showed that, days to seedling emergence, plant height at 6 weeks, number of leaves at 9 weeks, number of branches at 6 and 9 weeks were significantly ($P<0.001$) different among the various rates of NPK fertilizer application. The significant mean of 15.56 days, 44.58 cm, 41.38, 14.52 and 21.43 were recorded by Irish potatoes applied with 75 kg/hectare, except for the days to seedling emergency which was recorded by 0 kg/hectare. The result of the control treatment (0 kg NPK/ha) resulted in the longest seedlings emergence with a mean value of 15.56 days is not consistent with previous studies, which have shown that the absence of NPK fertilizer can promote early seedlings emergence in potatoes (Xu *et al*., 2025). According to Ojaghloo *et al*. (2015), the application of NPK fertilizer can delay seedlings emergence in potatoes. However, in this study, the 75 kg treatment resulted in the earliest seedlings emergence at days 13.59.

Application of 75 kg NPK/ha resulted in the tallest plants at 6 weeks, with a mean height of 44.58 cm. This agreed with the previous studies, which have shown that the application of NPK fertilizer can increase plant height in potatoes (Zhang *et al*., 2020). According to Girma (2020), the application of NPK fertilizer can increase plant height by providing essential nutrients for plant growth and development. The results of number of leaves at 9 weeks showed that the application

of 75 kg NPK/ha resulted in the highest number of leaves at 9 weeks, with a mean value of 41.38 leaves. This finding is in agreement with the work of Ali & Muhammad (2019) who reported that application of NPK fertilizer can increase the number of leaves in potatoes. Similarly, Zhang *et al*. (2020), reported that application of NPK fertilizer can increase the number of leaves by providing essential nutrients for leaf growth and development. Number of branches at 6 and 9 Weeks was highest at 75 kg NPK/ha with mean values of 14.52 and 21.43 branches, respectively. This is consistent with previous studies, which have shown that the application of NPK fertilizer can increase the number of branches in potatoes (Kabiri *et al.,* 2015). According to Ahmed and Alam (2017), the application of NPK fertilizer can increase the number of branches by providing essential nutrients for branch growth and development.

Mean Effects of Poultry Manure and NPK Fertilizer Application Rates on the Yield and Yield Components of Irish Potatoes at 3, 6, & 9 Weeks.

The results of yield and yield components of Irish Potatoes at various weeks (3, 6, & 9 Weeks) as affected by rate of poultry manure and NPK fertilizer application is presented in Table 3. The result revealed that days at first flower and tubers per plot were significantly ($P<0.01$) and yield per hectare was significantly affected by the rates of poultry manure application. However, days to tuber maturity and average tuber weight were not significantly different. Days to 1st flower was recorded by Irish potatoes applied with 3.5tonnes/hectare (73.13 days), number of tubers per plot (12.22) and tuber yield per hectare (599.58) were obtained by 7.5tonnes/hectare. The results of 1st day to flower showed that the application of 7.5 tonnes of poultry manure per hectare resulted in the earliest flowering with a mean value of 69.86 days. This is consistent with previous studies, which have shown that the application of organic manure can promote early flowering in potatoes (Ojaghloo *et al*., 2015).

Results of number of tubers per plot showed that the application of 7.5 tonnes of poultry manure per hectare gave the best results in terms of the number of tubers per plot, with a mean value of 12.22 tubers/plot. The report in this study is similar to the previous studies, which have shown that the application of organic manure can increase the number of tubers per plant in potatoes (Zhang *et al.,* 2020). According Amajad & Khan (2018), the application of poultry manure at a rate of 10 tons per hectare significantly increased the number of tubers per plant in potatoes. However, in this study, the application of 7.5 tonnes of poultry manure per hectare gave the best results. According to Zhang *et al*. (2020), the application of poultry manure at a rate of 5 tons per hectare significantly increased tuber yield in potatoes. 7.5 tonnes of poultry manure per hectare gave the best results in terms of tuber yield per hectare, with a mean value of 599.58 kg/ha. This is in conformity with early studies of Kabiri *et al*. (2015), which shown that the application of organic manure can increase tuber yield in potatoes.

Yield and yield components of Irish potatoes with different rate of NPK fertilizer application is shown in Table 3. The result showed that days to 1st flower and average tuber weight ($P<0.05$), number of tubers per plot and tuber yield per hectare ($P<0.001$) were significantly affected by the different rate of NPK application. However, days to tuber maturity was not statistically different. The results of days to first flower showed that the 75 kg NPK/ha treatment recorded the earliest flowering with a mean value of 70.33 days. This could be due to the fact that the treatment had adequate dose application of NPK fertilizer, which might have hastened flowering (Girma, 2020). According to Kabiri *et al*. (2015), nitrogen application can hasten flowering in potatoes. The report in this study is contrary to the report of Ojaghloo *et al*. (2015), who obtained insignificant mean in their work on effect of NPK fertilizer on yield and quality of potatoes tuber. Application of 75 kg NPK/ha gave the highest average tuber weight with a mean value of 127.28 g. This could be due to the fact that NPK fertilizer provides essential nutrients for tuber growth and development. According to Xu *et al*. (2025), NPK fertilizer application increased tuber weight by providing essential nutrients for tuber growth and development. Kabiri *et al*. (2015) also noted that "phosphorus application increased tuber weight by promoting root growth and development.

The results of number of tubers per plot revealed that the application of 75 kg NPK/ha gave the highest number of tubers per plot with a mean value of 12.67 tubers/plot. This could be due to the fact that NPK fertilizer promotes tuber formation and growth. Potassium application increased tuber number by promoting tuber formation and growth (Girma, 2020). Ojaghloo *et al*. (2015) also reported that NPK fertilizer application increased tuber number by providing essential nutrients for tuber growth and development. Tuber yield per hectare tuber yield per hectare with a mean value of 639.58 kg/ hactare was obtained by 75 kg NPK/hectare. This could be due to the fact that NPK fertilizer promotes tuber growth and development, leading to increased yields. According to Ojaghloo *et al.* (2015), NPK fertilizer application increased tuber yield by providing essential nutrients for tuber growth and development.

Mean Interaction Effect between Poultry Manure and NPK Fertilizer Application

The interaction effects between poultry manure and NPK fertilizer rates on yield and yield component of Irish potatoes is shown in Table 4. The result showed that plant height, number of leaves at 6 and 9 weeks, number of branches at 9 weeks, number of tubers per plant, tuber yield per plot and tuber yield per hectare were either significantly different at $P<0.01$ or $P<0.001$. The interaction between poultry manure and NPK fertilizer resulted in a significant increase in plant height at 6 weeks. This is because the poultry manure provided essential micronutrients such as boron, copper, and zinc, which are necessary for plant growth and development (Ojaghloo et al., 2015). Additionally, the NPK fertilizer provided the necessary macronutrients such as nitrogen, phosphorus, and potassium, which are essential for plant growth and development (Kabiri *et al.,* 2015). Adekiya & Agbede (2020) noted that, the application of organic manure and NPK fertilizer can increase plant height by providing essential nutrients for plant growth and development. The number of leaves at 6 and 9 weeks was best observed on plots where the application of poultry manure was 7.5 tonnes/ha and NPK was 75 kg/ha, resulting in 30.53 leaves at 6 weeks and 47.30 leaves at 9 weeks. The application of organic manure and NPK fertilizer can increase the number of leaves by providing essential nutrients for leaf growth and development (Zhang *et al*., 2020).

According to Adeyemi (2020), the application of organic manure and NPK fertilizer can increase the number of branches by providing essential nutrients for branch growth and development. This report is similar to the present study where interaction between poultry manure and NPK fertilizer rates resulted in a significant increase in the number of branches at 9 weeks. The interaction between poultry manure and NPK fertilizer rates also resulted in a significant increase in the number of tubers per plant. The best interaction was observed on plots where the application of poultry manure was 7.5 tonnes/ha and NPK was 75 kg/ha, resulting in 13.87 tubers per plant. According to Adekiya & Agbede (2020), the application of organic manure and NPK fertilizer can increase the number of tubers per plant by providing essential nutrients for tuber growth and development. The interaction between poultry manure and NPK fertilizer resulted in a significant increase in tuber yield per plot and per hectare. This is because the poultry manure provided essential micronutrients such as boron, copper, and zinc, which are necessary for tuber growth and development (Kabiri *et al*., 2015). Additionally, the NPK fertilizer provided the necessary macronutrients such as nitrogen, phosphorus, and potassium, which are essential for tuber growth and development (Zhang *et al*., 2020). As Ahmed & Alam (2022) noted that, the application of organic manure and NPK fertilizer can increase tuber yield by providing essential nutrients for tuber growth and development.

CONCLUSION

The study investigated the performance of Irish potatoes as affected by poultry manure and fertilizer rate application in Mubi, Northern Sudan savannah. The results showed that the best rate for poultry manure was 7.5 tonnes/ha, while the best rate for NPK fertilizer was 75 kg/ha. The combination of 7.5 tonnes PM and 7.5 kg NPK/ha was found to be the most effective in improving Irish potato performance.

The optimal combination of 7.5 tonnes PM + 7.5 kg NPK/ha (P_2 N_2) likely represents a harmonious balance between nutrient availability and soil health, thereby creating a conducive environment for

Irish potato growth and yield. This integrated fertilizer management approach not only enhances crop productivity but also contributes to improved soil fertility, reduced environmental degradation, and increased economic benefits for farmers.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

i. Farmers in Mubi and its environs are advised to apply 7.5 tonnes of poultry manure and 75 kg NPK fertilizer per hectare for optimal Irish potato performance.
ii. The combination of 7.5 tonnes PM and 7.5 kg NPK per hectare is recommended for the cultivation of Irish potato.
iii. Farmers should prioritize soil fertility management through the use of organic and inorganic fertilizers to improve soil fertility and crop yield.
iv. Further research is recommended to investigate the long term effects of poultry manure and NPK fertilizer application and soil fertility and crop performance.

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Table 1: Effect of Poultry Manure and NPK Fertilizer Application Rates on the Growth Performance of Irish potato

Treatments		Plant Height (cm)		No. of Leaves			No. of Branches		
P. Manure (kg ha^{-1})	**DSE**	**3 WAP**	**6 WAP**	**3 WAP**	**6 WAP**	**9 WAP**	**3 WAP**	**6 WAP**	**9 WAP**
9.5 t PM ha^{-1}	14.39^{b}	26.63	40.83^{b}	12.88^{c}	27.98^{ab}	39.51^{bc}	5.55^{b}	12.25^{b}	18.34^{b}
7.5 t PM ha^{-1}	14.03^{b}	27. 53	44.72^{a}	13.75^{a}	29.26^{a}	42.90^{a}	6. 36^{a}	13.77^{a}	20.27^{a}
5.5 t PM ha^{-1}	14.79ab	27.33	43.52^{a}	13.37^{b}	28.39^{ab}	39.99^{b}	6. 33^{a}	13.70^{ab}	20.08^{a}
3.5 t PM ha^{-1}	15.58^{a}	26.48	39.93^{b}	12.66^{c}	27.58^{b}	37.63^{c}	5.99^{ab}	12.45^{ab}	17.86^{b}
±SE	0.420	0.427	0.874	0.154	0.571	0.919	0.269	0.612	0.704
LOS	*	NS	**	**	NS	**	NS	NS	*
NPK Fertilizer									
100 kg NPK ha^{-1}	15.08^{ab}	26.77^{a}	41.98^{b}	13.25	28.08	40. 50^{a}	5.84	11.85^{b}	16.48^{b}
75 kg NPK ha^{-1}	13.59^{c}	27. 63	44.58^{a}	13.65	28.91	41.38^{a}	6.42	14.52^{a}	21.43^{a}
50 kg NPK ha^{-1}	14.56^{b}	27.06	44.38^{a}	13.28	28.83	40. 62^{a}	6.28	13.76^{a}	21.23^{a}
0 kg NPK ha^{-1}	15.56^{a}	26.49	38.05^{c}	12.48	27.39	37.53^{b}	5.70	12.03^{b}	17.42^{b}
±SE	0.447	0.542	1.018	0.354	0.408	0.743	0.185	0.685	0.618
LOS	***	NS	***	NS	NS	***	NS	***	***

^{a,b,c,d}Mean within the same column bearing different superscript (s) is significantly ($P \leq 0.05$), DSE= Days to Seedling Emergence, SE = standard error of the mean, LOS = level of significant, WAP = week after planting, NS = not significant, * = $P<0.05$, ** = $P<0.01$, *** $P<0.001$

Table 2: Effect of Poultry Manure and NPK Fertilizer Application Rates on the Yield and Yield Performance of Irish Potato

Treatments P. Manure (kg ha^{-1})	Days to 1st Flower	Days to Tuber Maturity	Average Tuber Weight	No. of Tuber per Plot	Tuber Yield per Hectare
9.5 t PM ha^{-1}	71.92^{a}	108.30	110.69	11.80^{a}	593.75^{a}
7.5 t PM ha^{-1}	69.86^{b}	98.38	126.45	12.22^{a}	599.58^{a}
5.5 t PM ha^{-1}	69.98^{d}	100.17	115.87	11.92^{a}	595.83^{a}
3.5 t PM ha^{-1}	73.13^{a}	118.81	121.21	11.10^{b}	555.00^{b}
±SE	0.707	12.77	9.722	0.183	12.113
LOS	**	NS	NS	**	*
NPK Fertilizer					
100 kg NPK ha^{-1}	71.52^{ab}	112.53	106.24^{b}	11.858^{b}	592.92^{b}
75 kg NPK ha^{-1}	70.33^{b}	99.76	127.28^{a}	12.675^{a}	639.58^{a}
50 kg NPK ha^{-1}	70.40^{b}	106.02	118.18^{ab}	12.608^{a}	634.17^{a}
0 kg NPK ha^{-1}	72.64^{a}	107.35	122.52^{a}	9.892^{c}	477.50^{c}
±SE	0.826	13.349	7.253	0.275	14.016
LOS	*	NS	*	***	***

^{a,b,c,d}Mean within the same column bearing different superscript (s) is significantly ($P \leq 0.05$), , SE = standard error of the mean, LOS = level of significant, NS = not significant, * = $P<0.05$, ** = $P<0.01$, *** $P<0.001$.

Table 3: Interaction Effect between Poultry Manure and NPK Fertilizer Application Rates on the Growth, Yield and Yield Components of Irish potato

Treatments P. Manure / NPK FERT.	Plant Height 6 WAP	No. of Leaves 6 WAP	No. of Leaves 9 WAP	No. of Branches 9 WAP	No. of Tubers per Plant	Tuber Yield per Plot	Tuber Yield per Hectare
P_1 N_1	29.97^{f}	27.533^{bcd}	35.433^{fg}	16.300^{gh}	8.167^{f}	196.00^{e}	408.33^{f}
P_1 N_2	44.20^{bc}	25.867^{d}	34.367^{g}	18.733^{defg}	12.133^{cd}	291.20^{bcd}	606.67^{cd}
P_1 N_3	42.96^{cd}	28.033^{bc}	40.267^{cde}	19.900^{cdef}	12.567^{bcd}	301.60^{bcd}	628.33^{bcd}
P_1 N_4	42 56^{cde}	28.867^{abc}	40.467^{cde}	16.500^{gh}	11.533^{d}	276.80^{d}	576.67^{d}
P_2 N_1	39.47^{de}	26.933^{cd}	38.400^{def}	17.867^{efgh}	9.033ef	216.80^{e}	451.67^{ef}
P_2 N_2	48.77^{a}	30.533^{a}	47.300^{a}	24.967^{a}	12.600^{bcd}	309.60^{abc}	645.00^{bc}
P_2 N_3	47.77^{ab}	30.267^{a}	45.100^{ab}	24.900^{ab}	13.867^{a}	332.80^{a}	716.67^{a}
P_2 N_4	40.97^{cde}	29.300^{ab}	40.800^{cd}	16.467^{gh}	11.700^{d}	287.20^{cd}	585.00^{d}
P_3 N_1	41.03^{cde}	27.367^{bcd}	37.133^{efg}	17.933^{efgh}	9.333^{e}	224.00^{e}	466.67^{e}
P_3 N_2	40.77^{cd}	28.767^{abc}	43.333^{bc}	21.067^{cd}	13.367^{ab}	320.80^{ab}	668.33^{ab}
P_3 N_3	47.90^{ab}	29.233^{ab}	38.833^{def}	32.400^{bc}	12.500^{bcd}	300.00^{bcd}	625.00^{bcd}
P_3 N_4	42.16^{cde}	28.200^{bc}	40.667^{cd}	15.767^{h}	12,.467^{bcd}	280.00^{cd}	623.33^{bcd}
P_4 N_1	41.73^{cde}	27.733^{bcd}	39.167^{de}	17.567^{fgh}	13.033^{abc}	283.20^{cd}	583.33^{d}
P_4 N_2	40.70cde	27.400^{bcd}	37.467^{defg}	20.133^{cde}	12.333^{bcd}	296.00^{bcd}	616.67^{bcd}
P_4 N_3	38.700^{e}	27.833^{bcd}	37.800^{defg}	18.500^{defgh}	11.767^{d}	282.40^{cd}	588.33^{cd}
P_4 N_4	42.200^{cde}	28.933^{abc}	43.600^{bc}	17.167^{fgh}	11.733^{d}	296.00^{bcd}	586.67^{d}
±SE	2.04	0.82	1.49	1.24	0.55	7.10	14.06
Level of Significant	***	**	***	**	***	***	***

a,b,c,- h Mean within the same column bearing different superscript (s) is significantly ($P < 0.05$) P_{1-4} = means (9.5, 7.5, 5.5, 3.5 tons Poultry manure per hectare^{-1}), N_{1-4} = means (100, 75, 50, 0 kg Nitrogen hectare $^{-1}$. WAP = Weeks after Planting, SE = Standard Error, LOS = Level of significant, **, = P<0.01, *** = P<0.001.

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