International Journal of Mechanical and Production
Engineering Research and Development (IJMPERD)
ISSN (P): 2249–6890; ISSN (E): 2249–8001
Vol. 11, Issue 4, Aug 2021, 137-146

APPLICATION WITH AND WITHOUT ZINC SULPHATE (ZNSO$_4$) AND NPK LEVELS ON THE GROWTH AND YIELD PERFORMANCE OF HIGH PROTEIN CORN (*ZEA MAYS* L)

ARNOLD V. DAMASO

Instructor I, College of Agriculture, Nueva Ecija University of Science and Technology- Gabaldon Campus, Gabaldon, Nueva Ecija 3131, Philippines

ABSTRACT

To increases production through agronomic procedures, fertilizer levels demand careful care in shifting climatic conditions that might boost a crop's value. To determine the effect of different levels of combined with or without ZnSO$_4$ and NPK levels on the growth and yield of high protein corn, an experiment was conducted using different treatments, application with and without ZnSO$_4$, and NPK levels (Fertilizer 1 100-40-20kgha^{-1}; Fertilizer 2 130-40-20kgha^{-1}; Fertilizer 3 160-40-20kgha^{-1}; Fertilizer 4 100-40-60kg ha^{-1}; Fertilizer 5 130-40-60kgha^{-1}; Fertilizer 6 160-40-60kg ha^{-1}). There was a significant interaction effect on plant stand at harvest, plant height at harvest, ear height, ear length, ear harvest per plot, kernel row per ear, number of kernels per ear, the weight of 1000 kernels, and estimated kernel yield, according to the results. The application of ZnSO$_4$ and NPK levels at 130-40-60kgha^{-1} and 10kg ZnSO$_4$ boosted the growth and yield parameters of high protein corn, according to the study's findings. The use of fertilizer combinations during crop production was found to be effective, contributing to the enhanced yield.

KEYWORDS: Growth, Crop Production, Zinc Sulphate, NPK Levels, High Protein Corn, Climate Change, Yield & Fertilizer

Received: Mar 05, 2021; **Accepted**: May 25, 2021; **Published**: Jun 15, 2021; **Paper Id**.: IJMPERDAUG202111

INTRODUCTION

In terms of economics, one of the primary variables that a producer may adjust to influence the yield of a specific crop is the integrated plant nutrient. Increased output through agronomic procedures, fertilizer levels, and plant spacing necessitate special care under changing climatic conditions that might boost a crop's worth. Corn (*Zea mays* L.) is a versatile cereal crop produced in tropical and temperate climates around the world. Increased competition among individual plants at progressively greater plant densities for finite resources such as N incident photosynthetically active sunlight, fertilizer management, and soil moisture results in increased plant-to-plant variability in modern corn production systems (Rao, 2013). Corn has a high nutritious value, despite its reputation as a poor man's diet. It's high in protein, fat, fiber, and vitamins and minerals like folate, iron, niacin, phosphorus, magnesium, copper, and zinc, as well as other nutrients like folate, iron, niacin, phosphorus, magnesium, copper, and zinc. Corn also contains lysine and tryptophan, two vital amino acids with a variety of health benefits (Salazar, 2016). An agronomical method that has been researched is increasing plant population density. This crop approach has evolved and will continue to evolve through time, with the most significant change being in the agronomic management aspect. Meanwhile, climate change must be addressed at the household level for poor and vulnerable individuals who rely on agriculture to be adequately targeted in research and development initiatives aimed at alleviating poverty. The use of NPK levels and Zinc Sulphate in corn production has a significant impact on agricultural climate change (Damaso, 2020). This research was established to support white corn production and promotion on a national level, including the creation of a more stable supply of white corn to meet the preferences of different regions, as well as the adaptation and dissemination of newly developed improved white corn varieties as a staple food alternative (Damaso, 2020). In general, the purpose of this study was to determine how nutrient management (NPK levels) and the application of with and without Zinc Sulphate ($ZnSO_4$). affected the development and yield performance of high protein corn Its specific goals were to determine the effect of various levels of nutrient management with or without Zinc Sulphate ($ZnSO_4$) on the growth and yield of high protein corn, as well as the interaction effect of NPK levels and the application of with and without Zinc Sulphate ($ZnSO_4$), and the effect of the application with and without Zinc Sulphate ($ZnSO_4$) that would yield the highest yield.

MATERIALS AND METHODS

The Split-plot in Randomized Complete Block Design (RCBD) was used in this investigation, which consisted of three blocks, each subdivided into three plots that represented the primary treatment (application of with and without Zinc Sulphate ($ZnSO_4$)) and sub-treatment (NPK Levels). The experimental area was laid out 4 meters wide and 5 meters long (4m x 5m) with a total of 20 square meters per plot and a 1.5-meter distance between blocks and 1.5 meters between plots were provided to maintained and ensure the full confinement of the applied fertilizers to avoid contamination. The experiment was carried out at the experimental area of Nueva Ecija University of Science and Technology, Gabaldon Campus, Gabaldon, Nueva Ecija, Philippines. In this investigation, the following treatments were used: A1 with $ZnSO_4$ (10 kg ha^{-1}) and A2 without $ZnSO_4$ are the main treatments (0) as well as for Sub-treatment: Levels of NPK: Fertilizer 1-100-40-20$kgha^{-1}$; Fertilizer 2 - 130-40-20$kgha^{-1}$; Fertilizer 3- 160-40-20$kgha^{-1}$; Fertilizer 4 - 100-40-60kg ha_{-1}; Fertilizer 5-130-40-60$kgha^{-1}$; Fertilizer 6-160-40-60$kgha^{-1}$. This study used a total experimental area of 2,000 square meters. This study used conventional tillage, which was fairly flat, well-drained, and assessed for suitable corn growing before being plowed and appropriately harrowed until the appropriate tilt was achieved.

EXPERIMENTAL OBSERVATION AND DATA ANALYSIS

In this study, growth and yield parameters such as plant stand at harvest (percent), plant height at harvest (cm), ear height (cm), ear length (cm), ear harvest per plot (percent), kernel row per ear, number of kernels per ear, the weight of 1000 per kernels (g), and computed kernel yield were gathered to measure the results of various treatments (ton ha^{-1}). All of the information gathered was categorized and tallied. The split-plot in Randomized Complete Block Design was evaluated using Analysis of Variance (ANOVA) (RCBD). The ANOVA was performed using the International Rice Research Institute – Statistical Tool for Agricultural Research (IRRI-STAR) version 2.0.1, and the means were compared using Tukey's Honest Significant Difference (HSD) Test at 0.05 and 0.01 percent confidence levels.

The Experimental Site's Physicochemical Characteristics of Soil

After the investigation, physicochemical properties of soil were determined from a composite soil sample taken from the experimental field at a depth of 0-25cm. The soil texture of the soil is clayey, and pH values varied from 5.8 to 6.03, which were moderately acidic and not on par with neutral soils, according to the results of the analysis of the chemical characteristics to the application of 10 kg ha^{-1} $ZnSO_4$ soil. The soil contained very little organic matter, ranging from 0.8 to 1.14 percent, and very little total nitrogen, ranging from 0.04 to 0.057 percent. Available phosphorous and exchangeable potassium were detected in the ranges of 24.07 to 40.32 ppm and 108.46 to 130.53 ppm, respectively. The amount of accessible zinc in the soil was measured and rated as corrective to maintenance, with a range of 0.7 to 1.57 ppm. However, the analysis of no application of $ZnSO_4$ indicated that the texture of the soil, pH value, organic matter, total nitrogen, available phosphorus, exchangeable potassium, and available zinc were noted in all treatments with the range and ratings of clayey; 5.89 to 6.05 – moderately acidic; 1.07 to 1.15% – very low; 0.053 to 0.06% – very low; 29.96 to 39.57 ppm – very high; 129.45 to 116.92 ppm – very high and 0.76 to 1.17 ppm – corrective to maintenance, respectively. Corn will adapt well to well-drained clayey, sandy loam to silty loam soil, according to Rao et al., (1995). As a result of the aforementioned, the soil texture is appropriate for corn production.

Table 1: The Experimental Site's Physicochemical Characteristics of Soil

Treatments	**Texture of Soil**	**pH**	**EC (mS/cm)**	**OM (%)**	**Total Nitrogen (N) (%)**	**Phosphorous (P_2O_5) (ppm)**	**Potassium (K_2O) (ppm)**	**Available Zinc (ppm)**
WZnSO$_4$F$_1$	Clayey	5.8	0.21	0.80	0.0400	24.07	108.46	0.66
WZnSO$_4$F$_2$	Clayey	5.97	0.27	0.97	0.0485	31.00	130.53	0.96
WZnSO$_4$F$_3$	Clayey	6.00	0.21	0.97	0.0485	26.06	118.79	0.85
WZnSO$_4$F$_4$	Clayey	6.03	0.22	1.04	0.0520	28.96	122.07	0.70
WZnSO$_4$F$_5$	Clayey	5.96	0.24	1.14	0.0570	36.56	118.79	1.08
WZnSO$_4$F$_6$	Clayey	5.86	0.25	1.08	0.0540	40.32	126.59	1.57
WoZnSO$_4$F$_1$	Clayey	6.05	0.28	1.06	0.0530	33.72	116.92	0.76
WoZnSO$_4$F$_2$	Clayey	5.90	0.23	1.20	0.0600	39.57	124.06	0.97
WoZnSO$_4$F$_3$	Clayey	5.89	0.28	1.14	0.0570	34.28	128.43	1.17
WoZnSO$_4$F$_4$	Clayey	6.03	0.26	1.15	0.0575	34.39	129.45	0.76
WoZnSO$_4$F$_5$	Clayey	5.99	1.07	1.07	0.0535	29.96	123.19	0.84
WoZnSO$_4$F$_6$	Clayey	6.04	0.25	1.06	0.0530	33.99	128.08	0.78

RESULTS AND DISCUSSIONS

The impact and interaction of NPK levels, as well as the application of with and without Zinc Sulphate ($ZnSO_4$) on the growth and yield performance of high protein corn, were studied in field trials. The following sections examine the findings of the study's parameters, namely: plant stand, plant height at harvest (cm), ear height (cm), and ear length (cm).

Growth Parameters

The results showed that NPK levels had a significant *($p \leq 0.05$)* impact on plant stand at harvest, but that there was no significant interaction between $ZnSO_4$ application and NPK levels. Fertilizer 6 had the highest plant stand at harvest, at 160-40-60kg $NP_2O_5K_2O$ ha^{-1}, with a mean of 99.33 percent, whereas Fertilizer 3 had the lowest plant stand at harvest, at 160-40-20kg $NP_2O_5K_2O$ ha^{-1}, with a mean of 96.80 percent (Table 2a). Higher fertilizer levels (NPK and $ZnSO_4$) boosted plant growth and development by improving nutrient uptake and enhancing photosynthetic material translocation, as well as reducing plant mortality due to nutrient competition, resulting in increased plant survival and as plant density increased, so did nitrogen need (Singh and Singh, 2002). Plant height of high protein corn as influenced by application with and without $ZnSO_4$ and NPK levels (Table 2b) was substantially affected *($p \leq 0.01$)* by application with and without $ZnSO_4$ and NPK levels. The maximum plant height of 267.17 centimeters was achieved with the application of $ZnSO_4$ at rates of 100-40-20 kg $NP_2O_5K_2O$ + 10 $ZnSO_4$ kgha^{-1} whereas the minimum plant height of 229.67 centimeters was achieved without the application of $ZnSO_4$ at rates of 100-40-60 kg $NP_2O_5K_2O$ ha^{-1}. The findings revealed that varied fertilizer levels in combination with zinc sulphate treatment enhanced plant height, boosted root growth, and strengthened the stem against lodging during protracted vegetative development. Plant height increased under these conditions if other environmental parameters, such as moisture and soil fertility, did not limit plant growth. Khalil et al. (1988); Bakht et al. (2006); Masood et al. (2011); Jeet et al. (2012); Seyyed et al. (2012); Adeniyan (2014) found that several fertilizer combinations improved plant height, and coupled application of Zn (2 percent) and NPK levels considerably boosted plant height. Application of $ZnSO_4$ and NPK levels significantly ($p \leq 0.05$) affected the ear height of high protein corn, however, there was no significant interaction between the application of $ZnSO_4$ and NPK levels (Table 3a). With a mean of 89.02 centimeters and 87.52 centimeters, respectively, the application without $ZnSO_4$ differed considerably from the application with $ZnSO_4$. On the other side, Fertilizer 2 had the highest NPK levels, with a mean of 89.80 centimeters and a rate of 130-40-20 kg $NP_2O_5K_2O$ ha^{-1}. Regardless of the 10 kgha^{-1} of $ZnSO_4$ used in the soil to aid improve and boost the growth of the plants, the results showed that applying zinc sulphate increased ear height. The effect of application with and without ZnSO4 on the ear length of high protein corn, as well as NPK levels, were substantially ($p \leq 0.01$) affected by ear length. Sillanpaa, (1990); Chang et al., (2007); and Alloway, (2007) all found similar results (2008). With no $ZnSO_4$ applied, the largest ear length (19.63 centimeters) was recorded at a rate of 160-40-60 kg $NP_2O_5K_2O$ ha^{-1}, whereas the shortest ear length (17.40 centimeters) was reported at a rate of 100-40-20 kg $NP_2O_5K_2O$ + 10 kg $ZnSO_4$ ha^{-1} (Table 3b). The results showed that as the fertilizer rate was increased in response to multi-nutrients applied to corn, ear length increased significantly, indicating that further rate increases did not affect any increment, which could be due to antagonistic effects of some nutrients to plan complex phenomena that occurred when nutrients were used in combination.

Table 2a: Interaction Effect of Application with and without $ZnSO_4$ and NPK Levels on Plant Stand at Harvest (%)($p \leq 0.05$) ($p \leq 0.01$) HSD on the Growth Performance of High Protein Corn

Application of $ZnSO_4$	Plant Stand at Harvest (%)						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With $ZnSO_4$	98.40	97.87	96.00	97.87	96.80	99.20	97.69
Without $ZnSO_4$	97.07	98.93	97.60	98.93	96.80	99.47	98.13
Mean	97.73^{ab}	98.40^{ab}	96.80^{b}	98.40^{ab}	96.80^{b}	99.33^{a}	

Table 2b: Interaction Effect of Application with and without $ZnSO_4$ and NPK Levels on Plant Height at Harvest (cm) ($p \leq 0.05$) ($p \leq 0.01$) HSD on the Growth Performance of High Protein Corn

Application of $ZnSO_4$	Plant Height at Harvest (cm)						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With $ZnSO_4$	267.17^{a}	258.17^{abc}	245.47^{c}	258.90^{ab}	259.27^{ab}	250.40^{bc}	256.56
Without $ZnSO_4$	256.63^{ab}	258.70^{ab}	264.80^{a}	249.67^{b}	261.90^{ab}	264.33^{a}	259.34
Mean	261.90	258.43	255.13	254.28	260.58	257.37	

Table 3a: Interaction Effect of Application with and without $ZnSO_4$ and NPK Levels on-Ear Height (cm) ($p \leq 0.05$) ($p \leq 0.01$) HSD on the Growth Performance of High Protein Corn

Application of $ZnSO_4$	Ear Height (cm)						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With $ZnSO_4$	88.80	88.93	87.53	86.87	86.23	86.77	87.52^{b}
Without $ZnSO_4$	87.63	90.67	90.93	87.80	88.33	88.77	89.02^{a}
MEAN	88.22^{a}	89.80^{a}	89.23^{a}	87.33^{a}	87.28^{a}	87.77^{a}	

Table 3b: Interaction Effect of Application with and without $ZnSO_4$ and NPK Levels on ear Length (cm) *($p \leq 0.05$) ($p \leq 0.01$)* HSD on the Growth Performance of High Protein Corn

Application of $ZnSO_4$	Ear Length (cm)						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With $ZnSO_4$	17.40^{c}	17.67^{bc}	18.03^{abc}	19.27^{a}	18.77^{ab}	17.90^{bc}	18.17
Without $ZnSO_4$	18.80^{ab}	17.80^{b}	18.73^{ab}	18.43^{ab}	18.13^{b}	19.63^{a}	18.59
Mean	18.10	17.73	18.38	18.85	18.45	18.77	

Yield and Yield Components

The ear harvest per plot of high protein corn was significantly affected *($p \leq 0.05$)* by application with and without $ZnSO_4$ and NPK levels (Table 4a). The maximum (99.73%) ear harvest per plot was obtained when no $ZnSO_4$ was applied at a rate of 160-40-60 kg $NP_2O_5K_2O$ ha^{-1}, while the minimum (97.05%) ear harvest per plot was reported when ZnSO4 was applied at a rate of 160-40-20 kg $NP_2O_5K_2O$ + 10 kg $ZnSO_4$ ha^{-1}. Increased ear harvest per plot with higher fertilizer levels allowed the plants to store nutrients with greater capacity, resulting in more ears, according to the findings. The findings of Akmal et al., (2010), Hamid et al., (2011), Rahmati (2012), and Nik et al., (2012). The kernel row per ear of high protein corn was significantly affected *($p \leq 0.01$)* by the interaction impact of application with and without $ZnSO_4$ and NPK levels (Table 4b). The maximum kernel row per ear (18.80) was observed when no $ZnSO_4$ was applied at a rate of 160-40-60 kg $NP_2O_5K_2O$ ha^{-1}, whereas the least kernel row per ear (15.20) was obtained when $ZnSO_4$ was applied at a rate of 160-40-60 kg $NP_2O_5K_2O$ + 10 kg $ZnSO_4$ ha^{-1}. The results showed that increasing fertilizer levels improved the development of kernel rows per ear by increasing the intake of all nutrients. The various micronutrients and their combinations were tested on corn plants, and they were found to be advantageous and effective in improving all physiological and yield characteristics of corn, as well as giving a positive response in terms of kernels row per ear of corn. A similar result was observed in the findings of Bakry et al., (2009); Geremew (2010) and Debebe (2010); Dawadi and Sah, (2012); Pandey and Chaudhary (2014). The number of kernels per ear of high protein corn was significantly affected ($p \leq 0.01$) by the application of ZnSO4 and NPK levels (Table 4c). As a result, the maximum number of kernels per ear (978.81) was recorded in the absence of ZnSO4 application at the rate of 160-40-20 kg $NP_2O_5K_2O$ ha^{-1}, while the minimum number of kernels per ear (712. 87) was recorded in the presence of $ZnSO_4$ application at the rate of 160-40-20 kg $NP_2O_5K_2O$ + 10 kg $ZnSO_4$ ha^{-1}. The findings revealed that the availability of nutrients applied (nitrogen and zinc levels) may have influenced the efficiency of plants to convert intercepted radiation into grain sink capacity; however, low fertilization may have harmed the efficiency of plants to convert intercepted radiation into grain sink capacity, as competition for photosynthates causes kernel abortion in corn. These findings backed up those of Akbar et al., (2002) and Rasheed et al., (2004); Muhammad et al., (2010); Ali and Raouf (2012); Gobeze et al., (2012); Himayatullah and Qasim (2015); Ijaz et al., (2016). (2015). The weight of 1000 high protein corn kernels was significantly changed *($p \leq 0.05$)* by application of $ZnSO_4$ and NPK levels, although the interaction was non-significant (Table 4d). The maximum weight of 1000 kernels was 0.313 kilograms at Fertilizer 3 with a rate of 160-40-20 kg $NP_2O_5K_2O$ ha^{-1}, while the minimum weight was 0.272 kilograms at Fertilizer 6 with a rate of 160-40-60 kg $NP_2O_5K_2O$ ha^{-1} Different combinations of fertilizer amounts and $ZnSO_4$ consistently enhanced corn grain weight and had a beneficial impact on nitrogen and zinc. Boosted nitrogen rates also increased enzyme activity in corn, possibly leading to increased kernel weight. Rasheed et al., (2004), Hamid et al., (2011), Kidisit (2013), and Mehdi and Bahram (2014) all found similar results.

The effects of treatment with and without ZnSO$_4$ and NPK levels on computed kernel yield of high protein corn (Table 4e) substantially affected computed kernel yield of high protein corn *($p \leq 0.05$)*. The maximum computed kernel yield (5.17 t ha^{-1}) was achieved with no ZnSO$_4$ treatment at a rate of 160-40-60 kg NP$_2$O$_5$K$_2$O ha^{-1}, whereas the smallest computed kernel yield (3.97 t ha^{-1}) was achieved with ZnSO$_4$ treatment at a rate of 160-40-20 kg NP$_2$O$_5$K$_2$O + 10 kg ZnSO$_4$ ha^{-1}. The response of corn to zinc and NPK levels on kernel yield rose significantly with the application of 160-40-20 kg NP$_2$O$_5$K$_2$O + 10 kg Zn ha^{-1} over control (100-40-20 kg NP$_2$O$_5$K$_2$O ha^{-1}) but statistically equaled 10 kg Zn ha^{-1}. The results revealed that greater NPK levels and zinc sulphate levels resulted in better kernel yields due to lower nutrient competition, allowing the plants to accumulate more biomass with a higher potential to convert more photosynthesis, resulting in the production of kernels. Tollenaar and Wu (1999), Muhammad Arif et al., (2010), and Saeed et al., (2010) all found similar results.

Table 4a: Interaction Effect of Application with and without ZnSO$_4$ and NPK Levels on-Eear *($p \leq 0.05$) ($p \leq 0.01$)* HSD on the Yield and Yield Components of High Protein Corn

Application of ZnSO$_4$	Ear harvest per plot (%)						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With ZnSO$_4$	97.85^{a}	98.90^{a}	99.17^{a}	98.91^{a}	98.61^{a}	97.05^{b}	98.41
Without ZnSO$_4$	97.80^{a}	97.83^{a}	97.81^{a}	98.38^{a}	98.63^{a}	99.73^{a}	98.36
Mean	97.82	98.37	98.49	98.64	98.62	98.39	

Table 4b: Interaction Effect of Application with and without ZnSO$_4$ and NPK Levels on Kernel Row per ear, *($p \leq 0.05$) ($p \leq 0.01$)* HSD on the Yield and Yield Components of High Protein Corn

Application of ZnSO$_4$	Kernel row per Ear						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With ZnSO$_4$	16.23^{a}	15.70^{a}	15.37^{a}	16.57^{a}	17.00^{a}	15.20^{a}	16.01
Without ZnSO$_4$	17.93^{abc}	15.73^{c}	17.90^{abc}	15.93^{bc}	17.97^{ab}	18.80^{a}	17.38
Mean	17.08	15.72	16.63	16.25	17.48	17.00	

Table 4c: Interaction Effect of Application with and without ZnSO$_4$ and NPK Levels on a Number of Kernels per Ear *($p \leq 0.05$) ($p \leq 0.01$)* HSD on the Yield and Yield Components of High Protein Corn

Application of ZnSO$_4$	Number of Kernels per Ear						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With ZnSO$_4$	871.55^{abc}	746.52^{bc}	712.87^{c}	972.89^{a}	918.44^{ab}	759.77^{bc}	830.34
Without ZnSO$_4$	898.32^{ab}	816.57^{ab}	978.81^{a}	910.14^{ab}	775.32^{b}	743.92^{b}	853.85
Mean	884.94	781.55	845.84	941.52	846.88	751.85	

Table 4d: Interaction Effect of Application with and without ZnSO$_4$ and NPK Levels on the Weight of 1000 kernels (kg) *($p \leq 0.05$) ($p \leq 0.01$)* HSD on the Yield and Yield Components of High Protein Corn

Application of ZnSO$_4$	Weight of 1000 Kernels (kg)						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With ZnSO$_4$	871.55^{abc}	746.52^{bc}	712.87^{c}	972.89^{a}	918.44^{ab}	759.77^{bc}	830.34
Without ZnSO$_4$	898.32^{ab}	816.57^{ab}	978.81^{a}	910.14^{ab}	775.32^{b}	743.92^{b}	853.85
Mean	884.94	781.55	845.84	941.52	846.88	751.85	

Table 4e: Interaction Effect of Application with and without $ZnSO_4$ and NPK Levels on Computed Kernel Yield (ton ha^{-1}) *($p \leq 0.05$) ($p \leq 0.01$)* HSD on the Yield and Yield Components of High Protein Corn

Application of $ZnSO_4$	Computed Kernel Yield (ton ha^{-1})						Mean
	NPK Levels						
	F1	F2	F3	F4	F5	F6	
With $ZnSO_4$	4.63^{a}	4.77^{a}	3.97^{b}	4.48^{ab}	4.53^{a}	4.26^{ab}	4.44
Without $ZnSO_4$	4.39^{b}	4.62^{ab}	5.09^{a}	4.78^{ab}	4.51^{ab}	5.17^{a}	4.76
Mean	4.51	4.69	4.53	4.63	4.52	4.71	

CONCLUSIONS

In terms of plant height, ear length, ear harvest per plot, kernel row per ear, number of kernels per ear, and computed kernel yield, a significant interaction was observed in the application of $ZnSO_4$ and NPK levels on the growth and yield performance of high protein corn. It was also noted that NPK levels had a substantial impact on ear height and plant stand at harvest, as well as the weight of 1000 kernels. $ZnSO_4$ and NPK levels of 130 – 40 – 60 kg $NP_2O_5K_2O$ ha^{-1} and 10 kg $ZnSO_4$ boosted growth metrics (plant stand at harvest, plant height, ear height) as well as yield and yield components (ear harvest per plot, kernel row per ear, number of kernels per row, ear length, and weight of 1000 kernels). This showed that using supplemental fertilizer combinations (chemical fertilizers) promoted and nourished plant growth and development, resulting in a better yield.

ACKNOWLEDGEMENT

The researcher appreciates the Department of Science & Technology –Science Education Institute-ASTHRDP for the financial and scholarship support, as well as the Nueva Ecija University of Science and Technology for the financial aid in publishing this research work.

REFERENCES

1. *Adeniyan O.N. and S.O. Ojeniyi. 2005. Effect of poultry manure, NPK 15-15-15 fertilizer, and combination on of their reduced levels on corn growth and soil chemical properties. Nigerian J. Soil Sci. 15: 34-41.*
2. *Anuj Kumar, Shailendra Singh Gaurav, Deepak Kumar Bahuguna, Priyanka Sharma, Tejbir Singh & Pooran Chand, "Analysis of Variability, Heritability and Genetic Advance for Yield and Yield Related Trait in Wheat (Triticum Aestivum L.) Genotypes",International Journal of Agricultural Science and Research (IJASR), Vol. 7, Issue 4,pp, 583-590*
3. *Adrian, O. N. 2014. Effect of different population densities and fertilizer rates on the performance of different corn varieties in two rain forest agroecosystems of southwest Nigeria. African Journal of Plant Science 8(8):410-415.*
4. *Chuwang Hijam & N. B. Singh, "Heterosis for Grain Yield and its Important Components in 77 Aromatic Rice (Oryza Sativa L.) ",International Journal of Agricultural Science and Research (IJASR),Vol. 9, Issue 2,pp, 75-80*
5. *Akbar, H., J. Miftahullah and M.T. Ihsanullah. 2002. Yield potential of sweet corn as influenced by different levels of nitrogen and plant population. Asian Journal of Plant Science 6: 631-633.*
6. *Sanjeev, U. Verma & M. Tonk, "Time-Series Modelling for Sugarcane Yield Estimation in Haryana",International Journal of Applied Mathematics & Statistical Sciences (IJAMSS),Vol. 4, Issue 6,pp 53-62*
7. *Ali, R. and S.S. Raouf. 2012. Effects of rates and nitrogen application timing on yield, agronomic characteristics, and nitrogen use efficiency in corn. International Journal of Agriculture and Crop Sciences 9: 534-539.*

8. *Megha Goyal & Urmil Verma, "Weather Based Wheat Yield Forecasting in Eastern Zone of Haryana",International Journal of Applied and Natural Sciences (IJANS),Vol. 7, Issue 4,pp; 19-22*

9. *Alloway, B.J. 2008. Zinc in Soils and Crop Nutrition. Second ed. International Zinc Association (IZA) and International Fertilizer Association (IFA), Brussels, Belgium, and Paris, France.*

10. *Akmal, M., H. Ur-Rehman, Farhufullah, M. Asim And H. Akbar. 2010. Response of corn varieties to nitrogen application for leaf area profile crop growth, yield, and yield components. Pakistan Journal of Botany 42(3): 1941-1947.*

11. *Bakht, J., S. Ahmad, M. Tariq, H. Akber and M. Shafi. 2006. Response of corn to planting methods and fertilizer N. J. Agric. Biol. Sci. 1(3): 8-14.*

12. *Bakry, R. A. Yasser, A. Soliman, and S. A. M. Moussa, Importance of micronutrients, organic manure and bio-fertilizer for improving corn yield and its components grown in desert sandy soil," Research Journal of Agriculture and Biological Sciences 5 (1): 16-23.*

13. *Chang, W.Y., B.Y. Lu, J.J. Yun, Y.L. Ping, Y. Zheng, X.S. Xin, L.G. An, S. Wei, and Z. Chun, 2007. Sufficiency and deficiency indices of soil available zinc for rice in the alluvial soil of the coastal yellow sea. Rice Science 14(3):223-228.*

14. *Damaso, A. V. 2020. Growth and Yield of High Protein Corn (Zea mays, L) as Influenced by Plant Spacing and NPK Levels. Faculty of College of Agriculture, Nueva Ecija University of Science and Technology – Gabaldon Campus, Gabaldon, Nueva Ecija 3131, Philippines. International Journal of Mechanical and Production Engineering Research and Development (IJMPERD) ISSN(P): 2249–6890; ISSN(E): 2249–8001 Vol. 10, Issue 3, Jun 2020, 2025–2032 © TJPRC Pvt. Ltd.*

15. *Dawadi, R., and S.K. Sah. 2012. Growth and yield of hybrid corn in relation to planting density and nitrogen levels during winter season in Nepal. Tropical Agricultural Research 23 (3): 218 – 227.*

16. *Debebe, D. 2010. Response of hybrid corn to Nitrogen and phosphors in Gedeo Zone Southern Ethiopia. Unpublished MSc Thesis, Haramaya University, Haramaya Ethiopia.*

17. *Dinh, H.G., E.D. Sarobol, and N. Sutkhet. 2015. Effect of plant density and nitrogen fertilizer rate on growth, nitrogen use efficiency, and grain yield of different corn hybrids under rainfed conditions in Southern Vietnam. Journal of Natural Science 49:1-12.*

18. *Geremewu, 2009. Effect of nitrogen and phosphorus fertilizers on the growth, yield, and yield components of corn (Zea mays L) at Nejo Western Wollega, Ethiopia. Unpublished MSc Thesis. School of Graduate Studies Haramaya University. p. 16 – 24.*

19. *Gobeze L., M.G. Ceronio and V.R. Daniel. 2012. Effect of row spacing and plant density on yield and yield component of corn (Zea mays L.) under irrigation. Journal of Agricultural Science and Technology 2: 263-271.*

20. *Hamid, A. and A.D.M. Nasab. 2001. The effect of various plant densities and N levels on the phonology of two medium maturity corn hybrids. Iranian Journal Agricultural Science, 32: 857-874.*

21. *Hamid, R.B., Z.D. Hamid, M.S. Seyyed, K. Abdolkarim, F. Amin, T. Fereshteh And A. Ebrahim. 2011. Effect of plant density and nitrogen fertilizer on yield and yield components of corn (Cultivar, SC704). World Applied Science Journal 13 (1):147-151.*

22. *Himayatullah and K.M. Qasim. 2015. Response of irrigated corn to trace elements in the presence of NPK. J. Sarhad Agri. 14(2):117-129*

23. *Ijaz, M., R.M.A. Sammar, A. Sajid, G. Kamran, A.Y. Tauqeer, S. Muhammad, and N. Muhammad. 2015. Differential planting density influences the growth and yield of hybrid corn. Journal of Environmental and Agricultural Sciences 2:3.*

24. *Jeet, S., J.P. Singh, R. Kumar, R.K. Prasad, P. Kumar, A. Kumari, and P. Prakash. 2012. Effect of nitrogen and sulfur levels on yield, economics, and quality of QPM hybrids under the dry land condition of eastern Uttar Pradesh, India Journal of Agricultural Sciences. 4 (9): 31-38.*

25. *Khalil, S.K., M.S. Afridi and M. Iqbal. 1988. Plant height, weeds weight, and hay yield of corn and mungbean in mono and associated culture as affected by NPK application. Sarhad Journal of Agriculture 4: 377-385.*

26. *Kidisit, A. 2013. Growth, productivity, and nitrogen use efficiency of corn (Zea mays L.) as influenced by rate and time of nitrogen fertilizer application in Haramaya District, Eastern Ethiopia. Unpublished MSc Thesis, Haramaya University, Haramaya Ethiopia.*

27. *Malakouti, M. J. 2008. The effect of micronutrients in ensuring efficient use of macronutrients. Turkish Journal of Agriculture 32(3): 215-220.*

28. *Masood, T. R., F. Gul, F. Munsif, Z. Jalal, N. Hussain, H. Noreen, Khan, Nasiruddin And H. Khan. 2011. Effect of different phosphorus levels on the yield components of Corn. Sarhad Journal of Agriculture 27(2): 167- 170.*

29. *Mehdi, S. and M. Bahram. 2014. Crop yield and weed biomass as affected by seeding rate and nitrogenous fertilizer case study: sc640; a new released cultivar. Indian Journal of Fundamental and Applied Life Science, 4 (4):74-81.*

30. *Mukhtar, T., M. Arif, S. Hussain, M. Tariq And K. Mehmood. 2011. Effect of different rates of nitrogen and phosphorus fertilizers on growth and yield of corn. J. Agric. Res. 49(3):333-339.*

31. *Muhammad A., T.J. Mohammad, U.K. Naqib, A. Habib, A.K. Shad, M. J. Khan, K. Ahmad, M. Iqbal, S. Muhammad And I. Aqib. 2010. Impact of plant populations and nitrogen levels on corn. Pakistan Journal of Biotechnology 42(6):3907-3913.*

32. *Negm.Y., B. Negm And F.A. Zahran, Optimization time of micronutrient application to wheat plants grown on sandy soils. Egyptian Journal of Agricultural Research 79 (3): 813-823.*

33. *Nik, M.M., Mahdi, B., T. Abolfazl And A. Ahmad. 2012. Effect of plant density on yield and yield components of corn hybrids (Zea mays L.). Scientific Research and Essays 6(22):4821-4825.*

34. *Pandey, B. And N.K. Chaudhary. 2014. Response of tillage system, nitrogen level and split application of nitrogen on spring corn in Chitwan, Nepal International Journal Applied Science Biotechnology 2(3): 298-301.*

35. *Rao, V. P. 2013. International Journal of Plant, Animal and Environmental Sciences. Agronomic Responses of Corn to Plant Population and Nitrogen Availability -A Review, 107-116.*

36. *Rao, I., Friesen, D. And Osaki, M. 1995. Plant adaptation to P-limited tropical soils. Handbook of Plant and Crop Physiology, pp 61 - 95. New York, USA.*

37. *Rahmati, H. 2012. Effect of plant density and nitrogen rates on morphological characteristics of grain corn. Journal of Basic and Applied Science Research 2(5): 4680-4683.*

38. *Rasheed, M., Ali, H., And T. Mahmood. 2004. Impact of nitrogen and sulfur application on growth and yield of corn crop. Pakistan Journal of Research (Science) 15: 153-157.*

39. *Rasheed, M., T. Mahmood, And M.S. Nazir. 2003. "Response of hybrid corn to different planting methods and nutrient management", Pakistan Journal of Agricultural Sciences 40(1-2): 39-42.*

40. *Saeed, M., A. Khaliq, Z.A. Cheema, And A.M. Ranjha. 2010. Effect of nitrogen levels and weed-crop competition durations on yield and yield components of corn. J. Agric. Res. 48(4): 471-481*

41. *Salazar, A. 2016. Importance of High Protein Corn as Staple Food. University of the Philippines Los Baños-Institute of Plant Breeding Journal, 1-10.*

42. *Seyyed, G. M., J.S. Mohamad And M. Ali. 2012. Effect of planting date and plant density on morphological traits, LAI, and forage corn (Sc. 370) yield in second cultivation. International Research Journal of Applied and Basic Sciences 3 (1):57-63.*

43. *Sillanpaa, M., 1990. Micronutrient assessment at the country level an international study. FAO, Rome, 63: 208*

44. *Tollenaar, M. and J. WU. 1999. Yield improvement in temperate corn is attributable to greater stress tolerance. Crop Science 39(6):1597-1604*

45. *Verma, A., V. Nepalia and P.C. Kanthaliya. 2017. Effect of integrated nutrient supply on growth, yield, and nutrient uptake by corn (Zea mays L.) wheat (Triticum aestivum L.) cropping system. Ind. J. Agron 51: 3-5.*