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THE INFLUENCE OF NITROGEN LEVELS ON THE GROWTH AND PRODUCTIVITY OF MAIZE (*ZEA MAYS* L.)

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ABSTRACT

Nitrogen is the essential nutrient that plays a vital role for protein synthesis, cell multiplication and differentiation. Nitrogen makes up approximately 1-4% of the dry matter and plays a crucial role in facilitating the movement of stored photosynthetic products and the absorption of other vital nutrient. The experiment was carried out at Agronomy Student field Department Sindh Agriculture University during 2022 autumn session. An experiment was laid out in Randomized Complete Block Design (RCBD) to determine the influence of different nitrogen levels on maize growth and seed yield. The experiment consists of four treatments of N levels repeated three times. The treatments include were, N_1 = 00 kg ha^{-1}, N_2 = 108 kg ha^{-1}, N_3 = 120 kg ha^{-1}, N_4 = 132 kg ha^{-1}. The analysis of variance (ANOVA) showed significant difference ($P<0.05$) for all growth and yield characteristics due to treatments, tallest plant (178.9 cm), maximum stem girth (12.5 cm), maximum number of internodes (13.5 plant^{-1}), maximum days taken to seedling emergence (7.6), maximum days taken to tasseling (66.6), maximum biological yield (13749.7 kg ha^{-1}) and maximum grain yield (4025.0 kg ha^{-1}) were recorded in treatment providing 132 kg N per Ha and lowest growth was in control (N1, no fertilizer) smallest plant (149.8 cm), minimum stem girth (9.7 cm), minimum number of internodes (10.8 plant^{-1}), minimum days taken to seedling emergence ((10.2), minimum days taken to tasseling (69.4), minimum biological yield (6249.7 kg ha^{-1}) and minimum grain yield (1952.3 kg ha^{-1}.It is concluded that maize performed better at treatment, T_4 – provided with N = 132 kg per Ha.

Key words: Maize, Growth, yield, Nitrogen.

INTRODUCTION

Maize (*Zea mays* L.) is a highly important crop worldwide, ranking third in global cereal crop production after wheat and rice. In Pakistan, maize is cultivated extensively across temperate, subtropical, and tropical regions, covering approximately 10.85 million hectares of land. The primary purpose of maize cultivation in Pakistan is to meet the forage and silage requirements of farm animals. Each year, Maize, also referred to as corn, holds the distinction of being the initial worldwide grain crop, as it contributes over 40% to the overall grain production with an impressive output of 1,125 million tons (FAO, 2018). Pakistan, in particular, plays a significant role in meeting this demand by producing an astounding 46.31 million tons of maize (Omar *et al.*, 2022). Due to its remarkable characteristics such as short growth duration, rapid growth rate, and widespread cultivation, maize possesses unparalleled potential among cereal crops. Its exceptional qualities have earned it the title of the "queen of cereals." No other cereal crop exhibits such immense capacity for growth and productivity as maize does (Begam *et al.*, 2018). Maize cultivation has been integrated as a prominent component in crop diversification initiatives and intensive cropping programs (Nasar *et al.*, 2022).Maize offers a versatile range of consumption options. It can be directly consumed as green cobs, roasted cobs, or popped grains. The grains themselves are utilized in numerous ways for human consumption, including the production of edible oil, cornmeal, fried grain, and flour. Maize is also valuable as animal feed, with both the green parts of the plant and the grains being used in livestock and poultry diets. Additionally, the sheaths of cobs find application in the production of higher quality cigarette paper. Moreover, the various components of maize such as Stover, dry leaves, cob coverings, and shelled cobs are highly regarded as fuel sources (Blandino *et al.*, 2022). Maize is a crop that has high nutrient demands and is considered an exhaustive feeder. Among the various nutrients, nitrogen is particularly crucial, and its fertilizer requirement surpasses that of other nutrients. Insufficient nitrogen supply during the critical tasseling and silking stages can have a significant impact on crop failure. However, the precise amount of nitrogen fertilizer to be applied to maize plants depends on factors such as the maize variety, soil type, fertility status of the crop, location, and desired yield (Chekole *et al.*, 2023). The application of nitrogen fertilizer is a crucial factor for achieving a high corn yield. The amount of nitrogen to be applied is primarily determined by the plant density, which refers to the number of plants per unit of cultivated land area. Optimal plant population, coupled with sufficient nutrient supply, particularly nitrogen, can lead to higher grain yields. Nitrogen is an essential nutrient that plays a vital role in protein synthesis, cell multiplication, and differentiation within corn plants. It also promotes the formation of chlorophyll pigment, thereby enhancing the process of photosynthesis and contributing significantly to the growth and reproductive phases of the crop. The nitrogen status of the plants has a significant impact on the biochemical processes, influencing physiological functions. Nitrogen accounts for approximately 1-4% of the dry matter in corn plants and also facilitates the translocation of stored assimilates and the uptake of other essential nutrients (Liu *et al.*, 2022 a). Improving nitrogen use efficiency in corn can be achieved through the application of an appropriate dosage at the right timing. However, providing a single recommended nitrogen level for corn is a challenging task without considering variations in location and numerous other factors. It is crucial to account for distinctions such as soil type, climate conditions, crop rotation, and management practices to determine the optimal nitrogen application rate for corn in specific locations. Taking these factors into consideration is essential for maximizing nitrogen use efficiency and ensuring optimal crop growth and yield (Anwar *et al.*, 2017). The effect of applying nitrogen fertilizers on maize plants can differ depending on factors such as the specific maize variety, geographical location, and the existing nutrient availability (Russo *et al.*, 2017).

MATERIALS AND METHODS

The field experiment took place at the Student's Experimental Farm, which is part of the Department of Agronomy at Sindh Agriculture University, Tandojam, during autumn, 2022 to assess the "impact of nitrogen levels on the growth and yield of maize (*Zea mays* L.)" The experiment was designed with randomized complete block design with net plot size 4m x 3m (12m^2). Mechanical implements were used to adopt a good seedbed with suitable land preparation as per recommended practice for maize. The experiment was repeated three times whereas Nitrogen was applied as per treatments. Examined treatments(Nitrogen levels) = 4 T_1 = Nitrogen @ 00 kg ha^{-1} (Control), T_2 = Nitrogen @ 108 kg ha^{-1}(10% < recommended), T_3 = Nitrogen @ 120 kg ha^{-1}(recommended), T_4 = Nitrogen @ 132 kg ha^{-1}(10% > recommended)at the time of maturity five plant was selected in each experimental plots and the units to measure, days taken to seedling emergence, plant height (cm), stem girth (cm), number of internodes plant^{-1}, days taken to tasseling, biological yield (kg ha^{-1}), grain yield (kg ha^{-1})were recorded.

Statistical analysis

The collected data underwent statistical analysis using ANOVA through Statistix-8.1 Computer Software (Statistix, 2006). In cases where it was required, the LSD test was utilized to compare the superiority of treatments.

RESULTS

The result proved the significant difference ($p<0.05$) in maize at various levels of nitrogen. The nitrogen 132 kg ha^{-1} produced better with maximum produced better with maximum days taken to seedling emergence of (7.6), followed by nitrogen was 120 kg ha^{-1} days taken to seedling emergence of (8.5), whereas days taken to seedling emergence of (9.4) was recorded where nitrogen was applied 108 kg ha^{-1} and the lowest days taken to seedling emergence of (10.2) observed when no apply nitrogen was control. The nitrogen 132 kg ha^{-1} produced better with highest plant height (cm) of (178.9), followed by nitrogen was 120 kg ha^{-1} plant height (cm) of (169.2), whereas plant height (cm)of (164.4) was recorded where nitrogen was applied 108 kg ha^{-1} and the minimum plant height (cm) of (149.8) observed when no apply nitrogen was control. The nitrogen 132 kg ha^{-1} produced better with highest stem girth (cm) of (12.5), followed by nitrogen was 120 kg ha^{-1} stem girth (cm) of (11.7), whereas stem girth (cm)of (10.6) was recorded where nitrogen was applied 108 kg ha^{-1} and the minimum plant height (cm) of (9.7) observed when no apply nitrogen was control. The nitrogen 132 kg ha^{-1} produced better with highest number of internodes (plant^{-1}) of (13.5), followed by nitrogen was 120 kg ha^{-1} number of internodes (plant^{-1}) of (12.8), whereas number of internodes (plant^{-1}) of (11.8) was recorded where nitrogen was applied 108 kg ha^{-1} and the minimum number of internodes (plant^{-1}) of (10.8) observed when no apply nitrogen was control. The nitrogen 132 kg ha^{-1} produced better with highest days taken to tasseling of (66.6), followed by nitrogen was 120 kg ha^{-1} days taken to tasseling of (67.5), whereas days taken to tasseling of (68.3) was recorded where nitrogen was applied 108 kg ha^{-1} and the minimum days taken to tasseling of (69.4) observed when no apply nitrogen was control. The nitrogen 132 kg ha^{-1} produced better with highest biological yield (kg ha^{-1}) of (13749.7), followed by nitrogen was 120 kg ha^{-1} biological yield (kg ha^{-1}) of (10416.3), whereas biological yield (kg ha^{-1}) of (9149.7) was recorded where nitrogen was applied 108 kg ha^{-1} and the minimum biological yield (kg ha^{-1}) of (6249.7) observed when no apply nitrogen was control. The nitrogen 132 kg ha^{-1} produced better with highest grain yield (kg ha^{-1})of (4025.0), followed by nitrogen was 120 kg ha^{-1} grain yield (kg ha^{-1}) of (3155.7), whereas grain yield (kg ha^{-1})of (2870.3) was recorded where nitrogen was applied 108 kg ha^{-1} and the minimum grain yield (kg ha^{-1})of (1952.3) observed when no apply nitrogen was control.

Table 1. Impact of Nitrogen Levels on the Growth and Yield of Maize.

Treatments	Days taken to seedling emergence	Plant height (cm)	Stem girth (cm)	Number of internodes plant^{-1}	Days taken to tasseling	Biological yield (kg ha^{-1})	Grain yield (kg ha^{-1})
T_1=No Nitrogen00 kg ha^{-1}	10.2 d	149.8 d	9.7 d	10.8 d	69.4 d	6249.7 d	1952.3 d
T_2=Nitrogen 108 kg ha^{-1}	9.4 c	164.4 c	10.6 c	11.8 c	68.3 c	9149.7 c	2870.3 c
T_3=Nitrogen 120 kg ha^{-1}	8.5 b	169.2 b	11.7 b	12.8 b	67.5 b	10416.3 b	3155.7 b
T_4=Nitrogen 132 kg ha^{-1}	7.6 a	178.9 a	12.5 a	13.5 a	66.6 a	13749.7 a	4025.0 a

DISCUSSION

The results demonstrated that the N_4 = (Nitrogen 132 kg ha^{-1}) the greatest plant height (178.9 cm), stem girth (12.5 cm), number of internodes (13.5 plant^{-1}), days taken to seedling emergence (7.6), days taken to tasseling (66.6), biological yield (13749.7 kg ha^{-1}) and grain yield (4025.0 kg ha^{-1}) and lowest resulted in smallest plant height (149.8 cm), minimum stem girth (9.7 cm), minimum number of internodes (10.8 plant^{-1}), minimum days taken to seedling emergence (10.2), minimum days taken to tasseling (69.4), minimum biological yield (6249.7 kg ha^{-1}) and minimum grain yield (1952.3 kg ha^{-1}). Similarly, Baloch et al. (2020) also observed that the minimum results shown of development and grain yield of maize and their several characteristics of agronomical. Maize plants require large quantities of nitrogen, with most of the required nitrogen being taken up during the vegetative stage. Nitrogen deficiency during the vegetative stage can result in stunted growth, delayed maturity, and reduced yield. In contrast, excessive nitrogen during this stage can lead to excessive vegetative growth, delayed tasseling and silking, and reduced kernel set, which ultimately results in reduced yield (Szulc *et al.,* 2023).Among them, nitrogen plays a crucial role in the growth of all living tissues. In order to obtain a bumper crop of maize, the application of the correct amount of nitrogen is considered key. Soil nitrogen deficiency adversely affects plant growth (Santos *et al.,* 2023) and the availability of soil N in appropriate amounts promotes vigor plant has play key role in plant expansion of the interception of solar radiation by plant canopies and (Bhat *et al.,* 2023). In Pakistan, farmers plant maize using a variety of sowing techniques, including bed, ridge and flat sowing. Flat sowing is the most common. Inadequate techniques of seeding result in a significant reduction in the amount of maize that can be grown in Pakistan, despite the fact that the country's climate and soil are ideal for growing the crop. Incorrect planting technique led to a decrease in germination, development and improvement, as well as ear size, as well as increased sensitivity to illnesses and lodging (Ali *et al.,* 2022).The relationship between nitrogen levels and the growth and yield of maize varies depending on the specific stage of growth, soil type, and environmental conditions. The recommended nitrogen application rate for maize varies depending on the soil fertility level and the yield potential of the crop. Generally, farmers aim to provide adequate nitrogen levels to the crop to ensure optimal growth and yield (Skarpa *et al.,* 2023).The farmer relies on antiquated methods of planting, which not only provide meager harvests but are also very arduous and time-consuming. The ridge planting of maize resulted in more advantages than the flat planting method, and it served as a replacement for the flat planting method (Liu *et al.,* 2022b). Ridge sowing resulted in better management of the soil and water as well as a reduction in the amount of time needed to finish the phonological phases, which ultimately led to increased yields of biological and grain products (Tucker *et al.,* 2020).

Conclusion

It is concluded that the maize growth and yield were influenced significantly ($p<0.05$) by nitrogen levels as compared to control (no fertilizer). The biological and grain yield increased linearly with increasing nitrogen levels. However, the plot fertilized with fertilizer of nitrogen @132 kg ha^{-1} produced highest biological yield (13749.7 kg ha^{-1}) and maximum grain yield (4025.0 kg ha^{-1}) of maize.

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