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Effects of varietal response and nitrogen levels on growth and yield of maize (*Zea may* L.)

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Abstract
A field experiment was conducted during kharif season of 2020 at Durtlang, Aizawl, Mizoram under the surveillance of Krishi Vigyan Kendra, CAU, Selesih,Aizawl, Mizoram, to study the growth and yield of maize (*Zea mays* L.) as influenced by varietal response and nitrogen levels. The experiment was compromised of Randomized Block Design with three replications and nine treatments. It consists of three varieties (Mimpui, Mimban and Puakzo) at three nitrogen levels (80,100 and 120 kg/ha). It was observed that T_5 (Mimban + 120 kg N ha^{-1}) gave highest plant height (238.07). However, T_7 (Mimpui + 120 kg N ha^{-1}) gave the highest dry weight (225.20g), number of grains row^{-1} (31.77), test weight (271.70g), grain yield (8.84t/ha) and stover yield (21.10 t/ha). It also gave highest net return of 104924.8, B:C ratio (4.29) as compared to the other treatments.

Keywords: Maize, nitrogen, variety, etc.

Introduction
Maize, a miracle crop is grown over a wide range of climatic conditions in semi-arid and subtropics on Indian continent. Water and nitrogen are the most important factors which play a major role in better growth and yield of maize (Hammed *et al*., 2011) [4]. Maize crop is adapted to a wide rand of climatic and edaphic conditions (Sharma and Das, 2012) [11] and has highest yield potential among cereals. In India it is cultivated in all seasons *viz*., kharif, rabi and summer. It plays key role in human diet and animal feed and provides adequate amount of energy and protein (Ipperisial *et al*., 1972).

Many exploration was undertaken during last two decades for collection of local maize from the Mizoram state. Since 1976, in the north-easterns hill (NEH) region intensive collections of landraces maize were made by ICAR-NBPGR, New Delhi and diversity from this region comprised 36 per cent of the total collection representing the highest number of accessions (Pandey *et al*., 2014) [7] Mizoram is also considered a rich genetic resource hill state in the North East for the existing diverse groups of flora and fauna. Among numerous cereal crops, traditional maize (*Zea mays* L.) belonging to the family Poaceae, commonly called Vaimin by the local people in Mizoram, occupies maximum area next to rice, widely grown in homestead and jhum areas under rainfed conditions.

Locally, Mizoram maize are mainly classified into three groups based on taste and uses i.e. Mimban (sticky/starchy), Mimpui (large cob/roasted/feed) and Puakzo (popcorn type) (Ratankumar *et al*.,2014) [8]. The sweet and sticky cobs (Mimbam) are boiled in hot water along with husk. The green ears are roasted on coals or boiled in water, and are eaten immediately on the cob. Mature dry grains are boiled and eaten whole, preferably mixed with pulses and vegetables, to produce a grain is also soaked and cooked in water, and is then ground to make dough that is converted into a sweet drink or an alcoholic drink by fermentation. Mimpui, bigger in cobs size are used for flour or feed preparation in Mizoram. Puakzo (popcorn) kernels are subjected to high temperatures of about in a hot plate to make them pop, since popcorn is a popular snack in Mizoram (Ratankumar *et al*., 2016) [9].

Nitrogen is a primary nutrient required by plants for their growth and development. Nitrogen plays a key role in vegetative growth and grain production of maize plant. It is essential for plants growth and grain production of maize plant and is still one of the major factors limiting crop yield. It is reported that application of nitrogen to maize increase fodder nutritive value by increasing crude protein and by reducing ash and fiber contents. Safder (1997) [10] concluded that plant height, stem diameter, green fodder yield, protein, fiber, and total ash contents were increased by increasing nitrogen levels. Mengel and Kirkby (2001) [6] mentioned that corn yield would have dropped by 41 per cent, respectively without nitrogen fertilizer application.

Management of irrigation water and nitrogen is crucial in order to improve maize productivity with reduced pollution risks (Gheysari *et al*., 2009) [3] as both of these factors had a positive correlation with maize productivity and can induce yield loss if applied in an inappropriate way 3 (Di Paolo and Rinaldi, 2008) [2]. Low yield of fodder maize is due to many constraints but NPK fertilizer application is one of the major factors (Witt *et al*., 2008) [12] Higher nitrogen levels are reported to increase plant height, stem thickness, leaf area, leaf area index, dry matter accumulation; net assimilates ratio and yield per hectares (Cheema *et al*., 2010) [1].

Materials and Methods

A field experiment was conducted during *kharif* season of 2020 at Durtlang, Aizawl, Mizoram under the surveillance of Krishi Vigyan Kendra, CAU, Selesih, Aizawl, Mizoram. The farm is situated at 23°47'32.1"N latitude, 92°43'57.4"E longitude (Google map 2021) and 1384 m altitude above the sea level (Altitude of Aizawl, Mizoram, 17th March, 2021). This area is located at the outskirt of Aizawl City near the campus of College of Veterinary Sciences & Animal Husbandry, Central Agricultural University. The experiment was compromised of Randomized Block Design with three replications and nine treatments. It consists of three varieties Mimpui, Mimban and Puakzo at three nitrogen levels 80 kg/ha,100 kg/ha and 120 kg/ha. During the growing season, the mean weekly maximum and minimum temperature, relative humidity and rainfall were 29.61 ℃, 20.5 ℃, 83.6%, 73.8% and 7.5mm respectively. Maize was sown at a spacing of 75 cm X 20 cm using seed rate of 20 kg/ha by *kera* method. The required nutrients were applied through Urea, SSP and MOP in which half doses of nutrients were applied as basal and the rest 50% were applied as split dose 35 DAS (days after sowing) and 45 DAS as top dressing. Observation on growth parameters, yield attributes, yield of maize varieties upon different nitrogen levels was recorded and their significance was tested by the variance ratio and relative economics was calculated as per the prevailing market prices of the inputs and produced during *kharif* season.

Results and Discussion

Growth parameter

The growth parameters of maize varieties with different nitrogen levels *viz*, Plant height (cm), dry weight of plant (g), Crop growth rate ($g/m^2/day$) and relative growth rate (g/g/day) which is varied due to different maize varieties with different levels of nitrogen application. The maize variety Mimban with the combination of 120kg/ha N resulted in higher plant height (238.07 cm). For dry weight of plants the treatment of Mimban + 120 kg/ha N was observed to be the highest plant height (225.20g) and the treatment Mimban + 100 kg/ha N (225.01) were found to be statistically at par with Mimban + 120 kg/ha N. At 100-120 DAS, the maximum crop growth rate (21.99 g m^{-2} day^{1}) was found on the treatment combinations of Puakzo + 80 kg/ha N. As for relative growth rate, at 100-120 DAS, the maximum relative growth rate (8.01 g/g/day) was recorded under the treatment combination of Mimban + 100 kg/ha N where the treatment Mimpui + 80 kg/ha N were found statistically at par with Mimban + 100 kg/ha N.

Table 1: Evaluation of Growth parameters of maize varieties with different Nitrogen levels

Treatments	Growth attributes (at 120 DAS)			
	Plant height (cm)	Dry weight (g/plant)	CGR100-120 DAS ($g/m^2/day$)	RGR 100-120 (g/g/day)
Mimpui + Nitogen 80kg/ha	176.33	185.36	8.36	7.27
Mimban + Nitrogen 100kg/ha	205.03	219.29	10.83	8.01
Puakzo + Nitrogen 120kg/ha	174.27	200.95	17.73	6.17
Mimpui + Nitogen 100kg/ha	197.00	219.55	8.92	6.50
Mimban + Nitrogen 120kg/ha	238.07	225.01	19.55	0.01
Puakzo + Nitrogen 80kg/ha	167.57	171.09	21.99	0.02
Mimpui + Nitogen 120kg/ha	201.77	225.20	9.78	6.8
Mimban + Nitrogen 80kg/h	204.53	182.33	11.88	3.20
Puakzo + Nitrogen 100kg/ha	165.80	173.08	16.32	0.02
SEd (±)	1.34	3.56	1.16	2.00
CD (p=0.05)	2.85	7.56	2.46	4.24

Yield attributes and Yield

Yield attributes such as Cobs per plant (No.), rows per cob (No.), grains per row (No.), seed weight per cob (g) and test weight (g) varied due to the influence of different varieties of maize with the treatment combination of different nitrogen levels are presented in Table 2. The variety Puakzo produced highest in cobs/plant (No.) (3). The treatment Mimban + Nitrogen 120kg/ha was recorded to produce highest in the yield attribute of Rows/cob (No.) (13.41) and the treatment Mimban + Nitrogen 100kg/ha and Puakzo + Nitrogen 120kg/ha were found to be statistically at par with Mimban + Nitrogen 120kg/ha. The treatment Mimpui + Nitogen 120kg/ha was recorded with higher yield attributes *viz*. Grain/rows (No.) (31.77), Seed weight/cob (88.57g), Test weight (271.70). Jassal (2013) reported a positive effect of nitrogen application on number of grains per row of maize. The interaction between different varieties and nitrogen levels was significant with respect to the number of grains per row. Mimpui + Nitogen 120kg/ha was also recorded with higher seed yield (8.84 t/ha), stover yield (21.10).

Table 2: Evaluation of yield attributes and yield of maize varieties and nitrogen levels

Treatments	Cobs/plant	Rows/cob	Grains/row	Seed weight/cob	Test weight	Grain Yield	Stover Yield	HI(%)
Mimpui + Nitogen 80kg/ha	2	12.01	30.31	74.10	238.27	7.76	18.53	41.86
Mimban + Nitrogen 100kg/ha	2	13.38	28.93	60.77	133.20	6.08	14.19	43.12
Puakzo + Nitrogen 120kg/ha	3	13.24	26.93	32.37	104.73	3.25	10.76	30.23
Mimpui + Nitogen 100kg/ha	2	12.72	30.89	82.20	254.73	8.31	19.78	42.02
Mimban + Nitrogen 120kg/ha	2	13.41	29.93	67.03	174.70	6.77	15.92	42.51
Puakzo + Nitrogen 80kg/ha	3	13.21	26.83	26.33	92.93	2.65	9.27	28.28

Mimpui + Nitogen 120kg/ha	2	13.10	31.77	88.57	271.70	8.84	21.10	41.90
Mimban + Nitrogen 80kg/h	2	13.33	28.95	57.40	124.10	5.76	13.41	42.98
Puakzo + Nitrogen 100kg/ha	3	12.98	27.28	28.23	95.57	3.01	10.03	30.00
SEd (±)		0.29	0.70	1.06	1.63	0.05	0.14	0.52
CD (p=0.05)		0.61	1.48	2.23	3.45	0.11	0.30	1.11

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