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Growth parameters and yield attributes as influenced by doses and split application of nitrogen on wheat in acidic soils of Meghalaya

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Abstract
A field experiment was conducted to study the effect of N doses and split application on plant height, dry matter production and yield of wheat in acidic soils of Meghalaya. Nitrogen application increased the plant height, dry matter production and yield. Nitrogen dose of 120 kg ha^{-1} in three equal split applications (1/3 at basal+1/3 at CRI+1/3 at booting) recorded significantly increased the plant height, dry matter production and yield of wheat compared to N as single basal application.

Keywords: Wheat, nitrogen, split application and yield

Introduction
Wheat is one of the important staple food crops of both the world and India after rice crop. It plays a significant role in eliminating global hunger. It is a good source of carbohydrates, minerals, vitamins, dietary fiber and a protein called Gluten. Gluten helps make the bread dough and sticks together. The whole wheat includes wheat germ and bran provides protection against diseases like diverticulitis, ischaemic, constipation, heart disease, appendicitis, diabetes and obesity. It is a widely adapted crop due to complexity of its genome which provides plasticity to the crop and is grown from temperate irrigated land to dry and high rainfall areas and from warm humid to dry cold environments. Globally, India ranks second for wheat production after China. It is the second important food crop after rice in India and the world. Wheat is contributing nearly 35 percent to the national food basket and plays an important role in food and nutritional security. This crop occupies area, production and productivity of 30.8 m ha, 98.5 Mt and 3.2 t ha^{-1}, respectively in India and finds a major place in meals of common population in major wheat growing states.
Nitrogen is one of the major nutrients which require more quantity by the crop plants to achieve higher yields (Finney *et al*., 1957; Delogu *et al*., 1998 and Zecevic *et al*., 2010 [5, 2, 10]. It consists of nucleic acids, ATP (adenosine triphosphate), and ADP (adenosine diphosphate) and help in cell growth and reproduction. Nitrogen deficiency in plant systems causes significantly reduction in plant growth and yields.
When nitrogen applied from the inorganic sources like urea it may prone to various losses like volatilization, leaching, surface runoff and denitrification. Almost 65% of area in Northeast India has soil acidity severity i.e. pH below 5.5 (Sharma and Singh, 2002) [9]. Optimum doses of N at critical growth stages like crown root initiation, active vegetative stage; booting and grain filling stages significantly improved the plant growth and yields.

Materials and Methods
A field experiment was conduct during *Rabi* season 2019-20 at College of Post Graduate Studies in Agricultural Sciences, Umiam, Meghalaya. The experimental field's soil had a pH of 5.4 with available nitrogen (277.22 kg ha^{-1}), available phosphorus (16.5 kg ha^{-1}), available potassium (235.32 kg ha^{-1}) and organic carbon (2.1%). Wheat variety Nw-1014 was sown. The seeds were sown manually with spacing of 20×5 cm.

0, 40, 80 and 120 kg N ha^{-1}were applied as per treatment and 40:40 Kg ha^{-1}, P_2O_5 K_2O were applied. The entire phosphorus and potassium dosage was applied as a basal. The experiment was laid out in FRBD (Factorial Randomized Block Design) replicated thrice with ten treatments *viz*., T0: Control, T_1: N40 as full basal, T_2: N20 as basal+N10 at CRI+N10 at booting, T_3: N13.33 at basal+N13.33 at CRI+N13.33 at booting, T_4: N80 as basal, T_5 N40 as 1/2 at basal + N20 as 1/4 at CRI + N20 as 1/4 at booting, T_6 N26.66 as 1/3 at basal + N26.66 as 1/3 at CRI + N26.66 1/3 at booting, T_7: N120 as basal, T_8 N60 as 1/2 at basal +N30 at CRI +N30 at booting and T_9 N40 as 1/3 at basal + N40 as 1/3 at CRI + N40 as 1/3 at booting. The data was analysed using standard statistical techniques.

Results and Discussion

Effect on plant height (cm)

Data on plant height presented in Table 1. N fertilized treatments found significantly higher plant height at harvest (102.17 cm) over control plot (94.33 cm). Imposition of different doses of N has resulted in significant variation among the treatments and higher plant height was recorded with application of 120 kg N $ha^{-1}$and lowest was recorded with control treatment. Maximum plant height was recorded (107.21 cm) with 120 kg N ha^{-1} which was significantly more over the plant height recorded from 80 kg N ha^{-1} (101.94 cm) and 40 kg N ha^{-1} (97.37 cm).

Effect on dry matter production (g $plant^{-1}$)

Data on dry matter accumulation presented in Table 1. N fertilized treatments found significantly higher plant dry matter (21.47 g) over control plot (12.31 g). Among the doses 120 kg N ha^{-1} recorded significantly higher dry matter accumulation over 80 kg N ha^{-1} and 40 kg N ha^{-1} and with respect to the split applications of 1/3 at basal + 1/3 at CRI + 1/3 at booting recorded higher dry matter followed by 1/2 at basal + 1/4 at CRI + 1/4 at booting and basal at the time of sowing.

Table 1: Plant height and dry matter accumulation of wheat as influenced by doses and split application of nitrogen

Treatments	Plant height (cm)	Dry matter accumulation
Control vs fertilized		
Control	94.33	12.31
Fertilized	102.17	21.47
S.E. (m)±	2.21	1.03
C.D (*p*=0.05)	6.57	3.07
Doses of Nitrogen		
40	97.37	17.31
80	101.94	22.45
120	107.21	24.66
S.E. (m)±	1.71	0.80
C.D (*p*=0.05)	5.09	2.38
Split application		
Basal	101.89	19.01
1/2 at basal + 1/4 at CRI + 1/4 at booting	101.64	21.85
1/3 at basal + 1/3 at CRI + 1/3 at booting	102.99	23.56
S. E. (m) ±	1.71	0.80
C.D (*p=0.05*)	NS	2.38

Effect on yield and yield attributes

Data on yield parameters presented in Table 1. The N fertilized plots were recorded significantly higher yield attributes like No. of panicles $plant^{-1}$ (2.09), Panicle length (8.70 cm), Grains $panicle^{-1}$ (6.63), Grains $plant^{-1}$ (63.52), Test weight (41.12) and Grain weight $plant^{-1}$ (2.58 g) over control (unfertilized) plots. Among the various doses120 kg N ha^{-1} was recorded higher yield attributes followed by 80 kg N ha^{-1} and 40 kg N ha^{-1}. Maximum yield attributes associated with N was applied in three equal split applications as 1/3 at basal+1/3 at CRI+1/3 at booting followed by 1/2 at basal+1/4 at CRI+1/4 at booting and single application as basal at the time of sowing.

Data on yield parameters presented in Table 2. Significantly higher yield was recorded with N fertilized treatments over control plots. The various doses brought significantly higher yields. The 120 kg N ha^{-1} was recorded higher economic yield (4.41t ha^{-1}), biological yield (13.31 t ha^{-1}) and straw yield (8.89 t ha^{-1}) and followed by 80 kg N ha^{-1} and 40 kg N ha^{-1}. Among the split application of N which was applied at equal split at 1/3 at basal+1/3 at CRI+1/3 at booting stage recorded significantly higher economic yield (4.25 t ha^{-1}), biological yield (13.10 t ha^{-1}) and straw (7.86 t ha^{-1}) yield over remaining two applications. The increase in yields may be due to correct application of N doses at critical stages of wheat crop influenced higher plant growth, photosynthesis and accumulation of dry matter in the plants and which combindly influenced the increase in higher yield attributes and it is resulted in higher yields of wheat. The similar results were reported by Deshmukh, Pandey, Biswas and Singh.

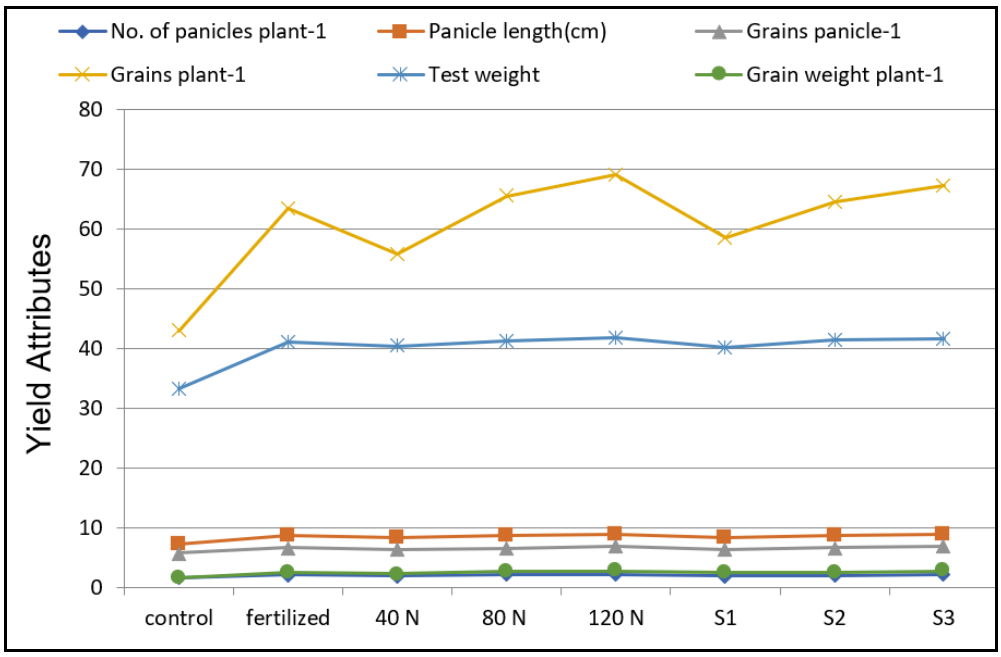

Fig 1: Yield attributes as influenced by various levels and split application of nitrogen on wheat

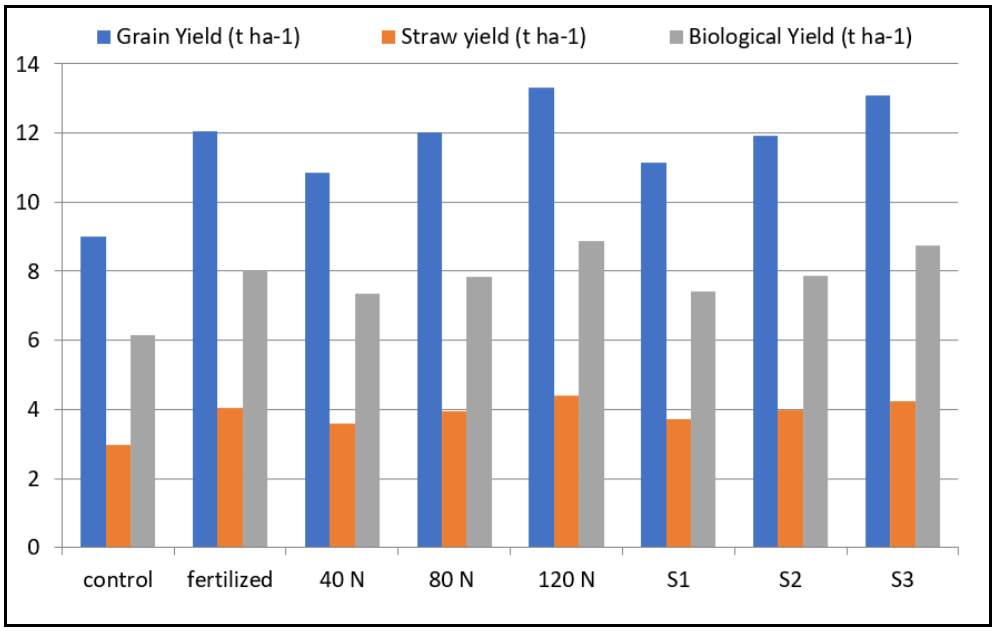

Fig 2: Grain Yield, Straw yield, Biological Yield influenced by various levels and split application of nitrogen on wheat

Table 2: Yield attributes of wheat as influenced by doses and split application of nitrogen

Treatments	No. of panicles plant^{-1}	Panicle length(cm)	Grains panicle^{-1}	Grains plant^{-1}	Test weight	Grain weight plant^{-1}
Control vs Fertilized						
Control	1.60	7.20	5.73	43.00	33.33	1.60
Fertilized	2.09	8.70	6.63	63.52	41.12	2.58
S. E. (m) ±	0.06	0.17	0.16	1.74	0.95	0.10
C.D (*p=0.05*)	0.19	0.51	0.47	5.17	2.84	0.29
Doses of nitrogen						
40	1.93	8.39	6.38	55.89	40.46	2.29
80	2.14	8.80	6.54	65.56	41.28	2.65
120	2.20	8.93	6.98	69.11	41.82	2.81
S. E. (m) ±	0.05	0.13	0.12	1.35	0.74	0.08
C.D (*p=0.05*)	0.15	0.39	0.37	4.00	2.20	0.23
Split application						
Basal	1.96	8.42	6.31	58.67	40.28	2.47
1/2 at basal+1/4 at CRI+1/4 at booting	2.06	8.74	6.64	64.56	41.48	2.51
1/3 at basal+1/3 at CRI+1/3 at booting	2.23	8.96	6.95	67.33	41.60	2.77
S. E. (m) ±	0.05	0.13	0.12	1.35	0.74	0.08
C.D (*p=0.05*)	0.15	0.39	10.37	4.00	2.20	0.23

Table 3: Grain, straw and biological yield and harvest index of wheat as influenced by doses and split application of nitrogen

Treatments	Biological Yield (t ha^{-1})	Grain yield (t ha^{-1})	Straw Yield (t ha^{-1})	Harvest Index (%)
Control vs Fertilized				
Control	8.99	2.98	6.14	32.33
Fertilized	12.05	4.05	8.02	33.49
S. E. (m) ±	0.41	0.12	0.52	2.06
C.D (*p=0.05*)	1.23	0.35	1.56	NS
Levels of nitrogen				
40	10.84	3.59	7.34	33.17
80	12.01	3.96	7.83	34.01
120	13.31	4.41	8.89	33.3
S. E. (m) ±	0.32	0.13	0.41	1.6
C.D (*p=0.05*)	0.95	0.39	1.21	NS
Split application				
Basal	11.16	3.73	7.43	33.82
1/2 at basal+1/4 at CRI+1/4 at booting	11.91	3.98	7.88	33.76
1/3 at basal+1/3 at CRI+1/3 at booting	13.10	4.25	8.76	32.9
S. E. (m) ±	0.32	0.13	0.41	1.6
C.D (*p=0.05*)	0.95	0.39	NS	NS

Conclusions

The yield of wheat crop is associated with N because it is an essential major primary nutrient helps in plant metabolism. Meghalaya is well known for its being top position as world wettest place with very high acidic soils. On the basis of the above-mentioned findings, it may be inferred that, the treatment with nitrogen level of 120 kg ha-1 was recorded significantly higher over other treatments. The split application of 120 kg N ha^{-1} along with proper acidic soil management can achieve higher grain yield and biological yield of wheat.

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