

# Study on the Growth and Yield Potential of Promising Wheat Genotypes under Modified Agronomical Practices

Moushumi Akhtar<sup>\*</sup>, Mosleh Ud-Deen, Ilias Hossain

**Abstract-** A field experiment was conducted to investigate the combined effect of NPKS (Nitrogen, Phosphorus, Potash and sulphur) fertilizer with cow dung on the growth and yield of promising wheat genotypes. Organic matter in the initial soil of the experimental field is very low (0.94%). The objective of study was to investigate the varietal/genotypic in producing maximum yield under different soil and environmental condition. To estimate the nutrient use efficiency of wheat genotypes and to support wheat breeding program in selecting the genotypes with relatively higher yield potential. To determine optimum rate of NPKS for wheat genotypes. The results revealed that maximum growth parameters responded significantly to NPKS fertilizers. Application of NPKS in combination increased wheat yield, gave the highest grain yield (4.21 t ha<sup>-1</sup>) from M<sub>4</sub> management, due the higher number of grains spike<sup>-1</sup> over nutrient management. The highest grain yield (4.29 t ha<sup>-1</sup>) was recorded from G<sub>3</sub> (BAW1161) genotypes. Among the interaction of nutrient management and genotypes produced the highest grain yield (4.60 t ha<sup>-1</sup>) in M<sub>4</sub>G<sub>3</sub> (i.e 150% RF+10 t ha<sup>-1</sup> cowdung and BAW1161) which may be considered as the best treatment combination. Different genotypes showed variable response to nutrient management.

**Index Terms** - growth, yield, wheat genotypes, potential yield, agronomical practices.

## I. INTRODUCTION

Wheat (*Triticum aestivum* L.) belonging to family Gramineae provides nutrition to a large world population (Heyne, 1987). It is the most important cereal crop and it ranks third both increase and production in the world (UNDP and FAO, 2008). It has been established as the second most important staple food crop after rice in Bangladesh. Bangladesh produces 13,48,186 M.tons of wheat per annum from 4,00,000 ha of land (BBS, 2016). Cereal crop production like wheat should be increased to meet the demand of the escalating population of Bangladesh, where an individual requires 454 g cereal food per day (BARI, 2004). Agricultural production has risen as fertilizer use has steadily increased (Tilman *et al.*, 2001).

Huge quantities of N fertilizer are commonly used to achieve high yields in cereals (Fixen and West, 2002). Potassium (K) is the third macronutrient required for plant growth, after nitrogen (N) and phosphorus (P). Potassium fertilizers are not subject to leaching or volatilization therefore can be applied to a wide range of application K has an important osmotic role in plants (Fageria *et al.*, 1991. Tisdai *et al.*, 1985).

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Approximately 3,518,000 tonnes of winter wheat were harvested from 815,000 ha in 2012, covering almost 33% of the Czech Republic cropland area (Czech Statistical Office, 2014). Rational use of organic and mineral fertilizers, based on the knowledge of their chemical composition, can lead to the same results as using mineral forms alone, thus reducing financial costs and not endangering the environment (Berenguer *et al.*, 2008).

During the process of variety selection trials are conducted under the common (Recommended) rates of fertilizer in different agro-ecological zones. Thus the varietal potentiality in producing maximum yield remained unknown. The yield potentiality of variety Kanchan was reported as 6.5 t/ha about two decade ago. Recently new varieties have been released which have higher biomass and yield. Some of the new genotypes are short in stature and thus resistant to lodging under the high fertility levels. Also the soil and environmental condition is being changed. Under the changed global conditions, we already experienced that food may not be affordable through import from other countries. Depending on global food policy and production, it may need to maximize wheat production beyond the economic profitability. All crop stages have a short duration, consequently, there are fewer days to accumulate assimilate during life cycle and production of biomass is reduced (Fischer and Maurer, 1974). It ultimately affects grain filling and lastly the yield of crop. Plant responses to high temperature vary with plant species, variety and phenological stages. Reproductive processes are markedly affected by high temperature which ultimately affects fertilization and post fertilization processes leading to reduced crop yield (Wahid *et al.*, 2007).

Nitrogen plays a vital role in growth processes as it is an integral part of chlorophyll, protein and nucleic acid (Marschner, 1995 and Jabber, 2009). NPK application is an important impact factor throughout the world including Bangladesh. Low quality seed, salinity, water logging, inadequate use of fertilizers, lack of irrigation water, high input prices, low farmer's education and no use of micronutrients and organic fertilizers are the major reasons for low wheat production (Khan *et al.*, 1999). Micronutrients deficiency is widespread in many Asian countries due to the calcareous nature of soils, high pH, low organic matter, salt stress, prolonged drought, high bicarbonate contents in irrigation water and imbalanced application of NPK fertilizers (Ahmad ikhah *et al.*, 2010). As the population continues to rise along with consumption expectations of new emerging economies, and with its food demand, food shortages will be unavoidable if agricultural production gains do not return to previous rates, at least keeping abreast of population growth (Khush, 1999). However, improvements

in crop productivity to meet the requirement mentioned above will not be easy without further technological breakthroughs that allow yield ceilings to be shifted through the development of new crop varieties (Rosenzweig and Parry, 1994). Organic matter in the initial soil of my experimental field is very low (0.94%) [Table 1]. In this context, we include cowdung for increase organic matter in soil fertility and productivity. Another NPKS are the key elements for yield potential in wheat genotypes due to their capability and efficiency. However we use cow dung as a source of organic matter and maximum use of nutrients for maximum potential yield in wheat genotypes. The composted organic wastes cannot only act as supplement to chemical fertilizers but may also improve the organic matter status and physico-chemical properties of soil (Harmsen *et al.*, 1994). Moreover, the information on yield potential of genotypes will be helpful to explore the varietal potentiality in maximizing wheat yield and to assist breeding program in selecting lines with higher yield potentials. The present experiment assigned with the following objectives : (i)To investigate the varietal/ genotypic in producing maximum yield under different soil and environmental condition (ii)To estimate the nutrient use efficiency of wheat genotypes and (iii) Support wheat breeding program in selecting the genotypes with relatively higher yield potential.

#### I. MATERIALS AND METHODS

The present research was carried out at Regional Wheat Research Centre, BARI ,Rajshahi, Bangladesh. During the rabi season from November 2015 to April 2016 to study the effects of nutrient management and genotypes on yield and yield attributes of wheat. In the main plot, 4 levels of soil management recommended fertilizer (N<sub>120</sub>P<sub>30</sub>K<sub>50</sub>S<sub>20</sub>), 100% of recommended fertilizer plus 5.0t/ ha cowdung , 150% of recommended fertilizer plus 5.0 t/ha cowdung , 150% of recommended fertilizer plus 10.0 t/ha cowdung with all the production package of WRC and six genotypes viz. BARI Gom 28, BAW 1151( BARI Gom 29), BAW 1161(BARI Gom 30), BAW 1170,BAW 1177 and BAW 1182 in sub-plot. A spit-spit plot design was used for the experiment by assigning nutrient management to the main plot, genotypes to the sub-plots. The treatments were replicated three times. The total number of unit plots in the entire experimental area was 6x4x3 = 72. The size of the each sub- plot was 5m×1m=5 m<sup>2</sup>.The experimental field was fertilized with above mentioned levels of nutrient management. Seeds were sown on 30 November 2015 in 25 cm apart rows opened by specially made an iron hand tine. Data of yield and yield attributes were recorded after harvesting. The recorded data were compiled and tabulated for statistical analysis. The data were analyzed statistically and the mean differences among the treatments were adjudged by Duncan’s Multiple Range Test (DMRT).

#### II. RESULTS AND DISCUSSION

The results obtained in this experiment consisting of four nutrient management and six genotypes have been presented in this chapter in tabular and graphical forms. The experiment was performed to examine the effect of nutrient management and six genotypes on the growth and yield and yield contributing characters of wheat.

#### 3.1.1 Total Dry Matter (TDM)

Total dry matter of six wheat genotypes at different stages of growth presented in (Fig. 1a). TDM increased steadily until tillering, and then increased sharply with the advancement of growth period upto physiological maturity.

**Table 1. Fertility status of initial soil sample of the experimental site at RWRC, BARI, Rajshahi, BANGLADESH**

Sample	P <sup>H</sup>	OM (%)	Total N(%)	K	P	Zn	B
				Meq/ 100g		µg/g	
Value	7.8	0.94	0.05	0.21	10	0.14	0.27
Critical level	-	-	0.12	0.12	10	0.60	0.20
Interpretation	Slightly Alkaline	Very low	Very low	Medium	Low	Very low	Very low

#### Effect of nutrient management

Nutrient management significantly influenced total dry matter at all sampling stages. In case of tillering stage, the maximum dry weight (11.74) found in M<sub>4</sub> nutrient management and minimum dry weight (9.95) in M<sub>1</sub>management. During the period of booting stage, highest dry weight (99.24) found in M<sub>4</sub> nutrient management and lowest dry weight ( 88.15) in M<sub>1</sub> nutrient management. At heading, highest dry weight was obtained at M<sub>4</sub> nutrient management (405.38) and lowest dry weight (380.27) in M<sub>1</sub> nutrient management. Incase of anthesis and physiological maturity, the maximum dry weight (793.04 and 977.99) found in M<sub>4</sub> nutrient management and minimum dry weight (765.20 and 944.07) in M<sub>1</sub> management (Figure 1.a).

#### Effect of genotypes

TDM varied significantly due to genotypes at tillering without others sampling stages (Fig. 1b). At tillering showed that the highest TDM (12.12) was obtained fromG<sub>6</sub>( BAW 1182) which statistically similar in G<sub>5</sub> and the lowest TDM (9.80) was found in G<sub>1</sub>(BARI Gom 28). For booting stage, highest TDM (94.74) was obtained from G<sub>6</sub> genotypes and minimum dry weight (91.02) in G<sub>1</sub> genotypes . At heading, highest dry weight in G<sub>6</sub>genotypes (393.84) and lowest dry weight (390.30) observed in G<sub>1</sub> genotypes. Incase of anthesis and physiological maturity, the maximum dry weight (785.31 and 954.15) foundin G<sub>6</sub>genotypes and minimum dry weight (774.56 and 960.41) in G<sub>1</sub> genotypes.

#### 3.1.2 Crop growth rate (CGR)

#### Effect of nutrient management

Significant differences were observed on CGR at Booting stage-tillering to except other stages. CGR increased significantly with increasing number of nutrient management.(Fig 2a). The highest CGR (3.50) was observed in M<sub>4</sub> which was statistically similar as M<sub>3</sub> due to nutrient management whereas the minimum CGR (3.13)of booting stage-tillering. Plants extended their luxurious growth up to anthesis. The highest CGR (15.31) and lowest (14.60) found in M<sub>4</sub> and M<sub>1</sub> nutrient management at heading stage-booting .However, anthesis- heading showed maximum CGR (25.84) and lower CGR (25.66) in M<sub>4</sub> and M<sub>1</sub> nutrient management. At physiological maturity-anthesis, the highest CGR (12.33)

and lowest (11.92) found in M<sub>4</sub> and M<sub>1</sub> nutrient management. During the time of maturity, most of the wheat crops gave similar CGR in both the growing seasons.

#### Effect of genotypes

Genotypes had not significant effects on CGR at all the growth stages. At Booting stage-tillering showed that the highest CGR (3.30) was obtained from G<sub>6</sub> (BAW 1182) and the lowest CGR (3.25) was found in G<sub>1</sub> (BARI Gom 28) (Fig 2b). For heading stage-booting stage, highest on CGR of genotypes (15.11) and minimum CGR (14.95) obtained from in G<sub>5</sub> genotypes and G<sub>1</sub> genotypes respectively. At anthesis-heading, highest CGR in G<sub>6</sub> genotypes (26.10) and lowest CGR (25.62) gained for G<sub>1</sub> genotypes. Incase of physiological maturity-anthesis, the maximum CGR (12.39) found in G<sub>4</sub> genotypes and minimum CGR (11.25) in G<sub>6</sub> genotypes.

### 3.3 Relative Growth Rate (RGR) (g g<sup>-1</sup> day<sup>-1</sup>)

#### Effect of genotypes

Genotypes was not significant effects on RGR at all the growth stages, but booting-tillering had significant effects on RGR due to genotypes. (Fig 3) At booting-tillering showed that the highest RGR (0.89) was obtained from G<sub>1</sub> (BARI Gom 28) and the lowest RGR (0.082) was found in G<sub>6</sub> (BAW1182). For heading -booting stage, highest RGR of genotypes (0.073) and minimum CGR (0.071) was observed at G<sub>1</sub> genotypes and G<sub>6</sub> genotypes. For this case, anthesis -heading the highest RGR in G<sub>1</sub> genotypes (0.046) and lowest CGR (0.045) was obtained from G<sub>6</sub> genotypes. Incase of physiological maturity-anthesis, the maximum RGR (0.014) found in G<sub>1</sub> genotypes and minimum RGR (0.013) in G<sub>6</sub> genotypes.

### 3.2.4 Leaf Area Index (LAI)

LAI is the ratio of total leaf area to ground cover and typically increases to a maximum after crop emergence. It is evident from the results that leaf area index increased linearly from one growth phase to another.

#### Effect of nutrient management

The data revealed that different macronutrients and their management did affect leaf area index significantly at all the growth stages without physiological maturity (Table-2). During the stage of tillering, the maximum LAI (0.085) found in M<sub>2</sub> nutrient management and minimum LAI (0.74) in M<sub>1</sub>. For this booting stage, highest LAI (1.42) was produced by M<sub>2</sub> nutrient management and lowest LAI (1.16) by M<sub>1</sub> nutrient management which was statistically identical similar with M<sub>3</sub>. At heading, highest LAI (2.74) found in M<sub>4</sub> nutrient management and lowest LAI (2.18) in M<sub>1</sub> nutrient management. Incase of anthesis, the maximum LAI (2.90) found in M<sub>4</sub> nutrient management which statistically similar with M<sub>2</sub> and M<sub>3</sub> management and lowest LAI (2.45) in M<sub>1</sub> nutrient management. However, physiological maturity showed that the maximum LAI (0.97) was recorded from M<sub>1</sub> and lowest value LAI (0.96) of M<sub>4</sub> nutrient management.

#### Effect of genotypes

LAI varied significantly due to genotypes at all sampling stages (Table 2). At tillering showed that the highest LAI (0.96) was obtained by G<sub>3</sub> (BAW 1161) and the lowest LAI (0.72) was found in G<sub>1</sub> (BARI Gom 28). For booting stage, highest LAI (1.69) was obtained by G<sub>3</sub> genotypes and minimum LAI (1.01) in G<sub>1</sub> genotypes (94.74g). At heading, highest LAI (2.90) was in G<sub>3</sub> genotypes and lowest (2.03) in

G<sub>1</sub> genotypes. Incase of anthesis and physiological maturity, LAI (3.04 and 1.11) found in G<sub>3</sub> genotypes and minimum LAI (2.60 and 0.88) in G<sub>6</sub> genotypes. Cao and Moss (1989) reported that total number of leaves and leaf area were reduced differently in different wheat genotypes.

#### Effect of interaction

Significant effect was observed on LAI due to the interaction between management and genotypes (Fig. 4) at all the stages. The maximum LAI (0.97) was obtained from the treatment combination of M<sub>3</sub>G<sub>3</sub> which was statistically identical similar with M<sub>2</sub>G<sub>3</sub> and the lower (0.55) was obtained from the treatment combination of M<sub>1</sub>G<sub>1</sub> at tillering. At booting stage, highest (1.78) was recorded from the treatment combination of M<sub>4</sub>G<sub>3</sub> which was statistically similar with M<sub>3</sub>G<sub>3</sub> and M<sub>2</sub>G<sub>3</sub>, however the lower (0.90) was obtained from the treatment combination of M<sub>3</sub>G<sub>6</sub>. At heading, highest LAI (3.15) produced by due to the interaction between management and genotypes and LAI (1.80) by M<sub>1</sub>G<sub>6</sub>. Incase of anthesis and physiological maturity, the maximum LAI (3.15 and 1.15) found in the treatment combination of M<sub>2</sub>G<sub>3</sub> and M<sub>1</sub>G<sub>3</sub> and the lower (2.21 and 0.80) was obtained from the treatment combination of M<sub>1</sub>G<sub>6</sub>.

Availability of sufficient nutrients resulted in higher leaf area, which in turn boosted the photosynthetic activity and ultimately higher dry matter accumulation.

**Table 2: Effect of genotypes and nutrient management on Leaf Area Index (LAI) at different stages of wheat**

Treatments	Tillering	Booting	Heading	Anthesis	Physiological Maturity
Management					
M <sub>1</sub>	0.74c	1.16c	2.18c	2.45b	0.97
M <sub>2</sub>	0.85a	1.42a	2.32b	2.80a	0.96
M <sub>3</sub>	0.81b	1.11c	2.37b	2.89a	0.97
M <sub>4</sub>	0.81b	1.35b	2.74a	2.90a	0.96
LSD(0.05)	0.02	0.05	0.12	0.11	ns
Genotypes					
G <sub>1</sub>	0.72d	1.01d	2.03e	2.63cd	0.94bc
G <sub>2</sub>	0.78c	1.15c	2.14de	2.69cd	0.97b
G <sub>3</sub>	0.96a	1.69a	2.90a	3.04a	1.11a
G <sub>4</sub>	0.84b	1.26b	2.68b	2.84b	0.96bc
G <sub>5</sub>	0.78c	1.26b	2.40c	2.75bc	0.92cd
G <sub>6</sub>	0.74d	1.18c	2.26cd	2.60d	0.88d
LSD(0.05)	0.03	0.06	0.14	0.13	0.05
CV (%)	4.65	4.44	5.39	4.45	7.59

LSD= Level of significant

CV= Co-efficient of variation

Difference

M<sub>1</sub>= Recommended fertilizer

G<sub>1</sub>= BARI Gom 28

M<sub>2</sub>= 100% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

G<sub>2</sub>= BAW 1151 (BARI Gom 29)

M<sub>3</sub>= 150% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

G<sub>3</sub>= BAW 1161 (BARI Gom 30)

M<sub>4</sub>= 150% Recommended fertilizer plus 10 t ha<sup>-1</sup> cowdung (CD)

G<sub>4</sub>= BAW 1170

G<sub>5</sub>= BAW 1177

G<sub>6</sub>= BAW 1182

**Table 3a. Effect of genotypes and nutrient management on yield components of wheat**

Treatments	Plant height (cm)	Plant population (m <sup>-2</sup> )	Spike length (cm)	Spikelets spike <sup>-1</sup>	Grains spike <sup>-1</sup>	1000 grain weight (g)
Management						
M <sub>1</sub>	86.11d	141.66d	10.04	16.72	43.53bc	40.96
M <sub>2</sub>	88.63c	153.68c	10.23	16.13	42.91c	39.74
M <sub>3</sub>	95.60b	168.92b	10.75	16.85	45.14ab	38.01
M <sub>4</sub>	98.26a	188.94a	10.77	16.80	46.33a	43.32
LSD(0.05)	2.65	6.80	ns	ns	3.20	ns
Genotypes						
G <sub>1</sub>	89.20b	154.10d	10.43b	16.20	44.35	39.03
G <sub>2</sub>	86.67bc	157.97cd	9.94b	16.23	43.97	41.32
G <sub>3</sub>	92.84a	161.12bcd	11.17a	17.33	47.25	43.45
G <sub>4</sub>	78.95d	164.65abc	10.41b	16.53	46.08	38.48
G <sub>5</sub>	90.34b	168.38ab	10.33b	16.53	44.43	39.53
G <sub>6</sub>	88.41b	172.68a	10.41b	16.95	43.78	41.25
LSD (0.05)	3.25	8.33	0.65	ns	ns	ns
CV (%)	7.48	4.72	7.64	11.05	10.69	12.18

**Table 3b: Interaction effect of genotypes and nutrient management on yield and yield contributing characters of wheat**

Management X Genotypes	Plant height (cm)	Plant population (m <sup>-2</sup> )	Spike length (cm)	Spikelets spike <sup>-1</sup>	Grains spike <sup>-1</sup>	1000 grain weight (g)	Grain yield (t ha <sup>-1</sup> )	Straw yield (t ha <sup>-1</sup> )	Biological yield (t ha <sup>-1</sup> )
M <sub>1</sub> G <sub>1</sub>	91.67a	135.26	10.11cd	16.45	43.19	42.44	3.05j	4.12	7.17
M <sub>1</sub> G <sub>2</sub>	85.78abcd	137.37	9.05f	15.67	41.11	40.88	4.40abc	3.68	8.08
M <sub>1</sub> G <sub>3</sub>	79.44def	139.86	10.64bcd	17.44	46.44	36.15	4.29abcd	3.42	7.72
M <sub>1</sub> G <sub>4</sub>	84.11bcde	142.75	10.67bcd	16.44	42.89	42.87	4.15bcd	3.81	7.96
M <sub>1</sub> G <sub>5</sub>	91.67a	145.80	9.52ef	16.77	43.67	41.27	3.10j	4.29	7.39
M <sub>1</sub> G <sub>6</sub>	84.00bcde	148.95	10.22cd	17.55	43.89	42.18	4.12cde	3.55	7.67
M <sub>2</sub> G <sub>1</sub>	86.56abc	146.81	9.86def	15.55	44.78	39.39	4.13cde	3.60	7.72
M <sub>2</sub> G <sub>2</sub>	88.33abc	149.31	10.10cd	15.66	40.33	44.88	4.50ab	3.42	7.92
M <sub>2</sub> G <sub>3</sub>	90.11ab	151.90	10.44bcd	17.22	42.33	42.62	3.50ghi	4.07	7.57
M <sub>2</sub> G <sub>4</sub>	86.67abc	154.70	9.88def	16.11	45.44	39.73	3.83fg	3.94	7.78
M <sub>2</sub> G <sub>5</sub>	87.89abc	157.65	11.33abc	16.56	43.89	42.15	4.15bcd	3.99	8.14
M <sub>2</sub> G <sub>6</sub>	92.22a	161.71	9.77def	15.67	40.67	43.99	3.97def	3.64	7.61
M <sub>3</sub> G <sub>1</sub>	90.11ab	160.15	10.42bcd	17.11	45.33	41.84	4.21bcd	4.42	8.63
M <sub>3</sub> G <sub>2</sub>	83.35cde	163.30	10.32bcd	16.67	45.33	40.42	4.45abc	4.12	8.57
M <sub>3</sub> G <sub>3</sub>	90.89a	166.63	10.53bcd	17.78	51.56	37.95	4.20bcd	4.33	8.54
M <sub>3</sub> G <sub>4</sub>	70.90g	170.39	12.56a	15.00	50.11	34.59	4.11cde	4.25	8.35
M <sub>3</sub> G <sub>5</sub>	90.00ab	174.38	10.00def	16.89	46.81	33.18	3.85efg	4.77	8.62
M <sub>3</sub> G <sub>6</sub>	88.33abc	178.66	10.67bcd	17.67	43.67	40.07	3.25hij	4.81	8.06
M <sub>4</sub> G <sub>1</sub>	88.44abc	177.76	11.33abc	15.67	44.11	42.95	3.20ij	4.29	7.49
M <sub>4</sub> G <sub>2</sub>	89.22abc	181.92	10.29bcd	16.92	49.11	39.09	3.59gh	4.46	8.05
M <sub>4</sub> G <sub>3</sub>	78.90ef	186.08	10.00def	16.89	50.55	46.58	4.60a	4.25	8.85
M <sub>4</sub> G <sub>4</sub>	74.11fg	190.77	11.55ab	18.55	43.10	36.74	4.12cde	4.16	8.28
M <sub>4</sub> G <sub>5</sub>	91.80a	195.72	10.44bcd	15.89	43.33	41.52	3.40hij	4.72	8.12
M <sub>4</sub> G <sub>6</sub>	89.07abc	201.38	10.99bcd	16.89	46.89	38.76	3.12j	4.64	7.76
LSD (0.05)	6.50	ns	1.30	ns	ns	ns	0.36	ns	ns
CV (%)	7.84	4.72	7.64	11.05	10.69	12.18	8.22	8.12	5.05

CV= Co-efficient of variation

M<sub>1</sub>= Recommended fertilizer

M<sub>2</sub>= 100% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

M<sub>3</sub>= 150% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

M<sub>4</sub>= 150% Recommended fertilizer plus 10 t ha<sup>-1</sup> cowdung (CD)

LSD= Level of significant Difference

G<sub>1</sub>= BARI Gom 28

G<sub>2</sub>= BAW 1151 (BARI Gom 29)

G<sub>3</sub>= BAW 1161 (BARI Gom 30)

G<sub>4</sub>= BAW 1170

G<sub>5</sub>= BAW 1177

G<sub>6</sub>= BAW 1182

### 3.5 Effect on yield and yield contributing characters of wheat genotypes

#### 3.5.1 Plant height

##### Effect of nutrient management

Data pertaining to the final plant height as affected by different NPKS levels are given in Table 3a. The analysis of variance revealed that different levels of NPKS differ significantly from each other. Maximum plant height (98.26cm) was attained when NPKS was applied at the rate of 180-45-75-30 plus 10 t/ha against minimum plant height (86.11cm) was observed from M<sub>1</sub> treatments. The plant height increased linearly with each successive increase in NPKS which was attributed to the gradual increase in plant height. These results are in agreement with Ayub *et al.*, (2002); Maqsood *et al.*, (2001).

##### Effect of genotypes

Plant height was varied significantly with genotypes. The highest plant height (90.41cm) was recorded in G<sub>4</sub> and the lowest plant height (78.955cm) was measured in G<sub>4</sub> (Table 3a).

##### Effect of interaction

Significant effect was observed on plant height due to the interaction between management and genotypes (Table 3b) indicates that the tallest plant (90.80cm) was obtained from the treatment combination of M<sub>4</sub>G<sub>5</sub> and the shortest plant (70.90cm) was obtained from the treatment combination of M<sub>3</sub>G<sub>4</sub>.

#### 3.5.2 Number of Plant population m<sup>-2</sup>

##### Effect of nutrient management

Three times plus one additional irrigation of M<sub>4</sub> management plant gave highest plant population per m<sup>2</sup> (188.94) and one irrigation plus M<sub>1</sub> management treated plot gave (141.66) population at 5% level of significance (Table 3a).

##### Effect of genotypes

Genotypes had significant effect on plant population per m<sup>2</sup> at 5% level of significance (Table 3.a). The highest number of plant population per m<sup>2</sup> (172.68) was resulted from G<sub>6</sub> (BAW1180) and lower number of plant population per m<sup>2</sup> (154.10) was produced by G<sub>1</sub> (BARI Gom 28).

##### Effect of interaction

Significant effect was not observed on the interaction effect of nutrient management and genotypes. Numerically the highest number of plant population per m<sup>2</sup> (201.38) was found in M<sub>4</sub>G<sub>6</sub> treatment combination and lower number of plant population per m<sup>2</sup> (135.26) was produced by M<sub>1</sub>G<sub>1</sub> treatment combination (Table 3b).

#### 3.5.3 Spike Length

##### Effect of nutrient management

Effect of nutrient management significant variation in spike length was not observed with the variation of nutrient management (Table 3.a). The G<sub>4</sub> plants had the highest spike length (10.77cm) under M<sub>4</sub> and the M<sub>1</sub> plant had the lowest spike length (10.04cm).

##### Effect of genotypes

Length of spike varied significantly due to genotypes. G<sub>3</sub> genotypes (BAW 1161) produced the spike Length (11.17cm), whereas the lower spike Length (9.94cm) was observed in G<sub>2</sub> (BARI Gom 29) (Table 3a)

##### Effect of interaction

Significant effect was not observed on the interaction effect of nutrient management and genotypes. Numerically the highest Spike Length (12.56 cm) was found in M<sub>3</sub>G<sub>4</sub> treatment combination and lower spike Length (9.05cm) was produced by M<sub>1</sub>G<sub>2</sub> treatment combination (Table 3b).

#### 3.5.4 Number of spikelet's spike<sup>-1</sup>

##### Effect of nutrient management

Significant variation in was number of spikelets spike<sup>-1</sup> not observed with the variation of nutrient management (Table 3.a). The G<sub>4</sub> plants had the highest (16.85) number of spikelets spike<sup>-1</sup> under M<sub>3</sub> and the M<sub>2</sub> plant had the lowest (16.13) number of spikelets spike<sup>-1</sup>.

##### Effect of genotypes

Number of spikelets spike<sup>-1</sup> was not significantly affected by genotypes (Table 3a). The highest number of spikelets spike<sup>-1</sup> (17.33) from G<sub>3</sub> the lowest number of spikelets spike<sup>-1</sup> (16.20) from G<sub>1</sub> (BARI Gom 28).

##### Effect of interaction

There was not significant effect in respect of number of spikelets spike<sup>-1</sup> due to nutrient management and genotypes combination. The highest number of spikelets spike<sup>-1</sup> (17.67) was obtained from the M<sub>3</sub>G<sub>3</sub> and the lowest number of spikelets spike<sup>-1</sup> (15.0) was obtained from the M<sub>3</sub>G<sub>4</sub> combination (Table 3b).

#### 3.5.5 Number of grains spike<sup>-1</sup>

##### Effect of nutrient management

Number of grains spike<sup>-1</sup> was statistically significant over different nutrient management. The highest number of grains per spike (46.33) from M<sub>4</sub> showed and the lowest (42.91) from M<sub>2</sub> management (Table 3a)

##### Effect of genotypes

Number of grains spike<sup>-1</sup> was not found to be significant in respect of genotypes (Table 3.a). The highest number of grains per spike (47.25) from G<sub>3</sub> showed and the lowest (43.78) from G<sub>6</sub> genotypes.

##### Effect of interaction

Significant difference was not observed in terms of grains spike<sup>-1</sup> due to the interaction between nutrient management and genotypes. Numerically, the highest number of grains spike<sup>-1</sup> (51.56) was produced by the interaction of M<sub>4</sub>G<sub>3</sub> and the lowest number of fertile seeds spike<sup>-1</sup> (40.33) was produced by the treatment combination of M<sub>2</sub>G<sub>2</sub> (Table 3. b).

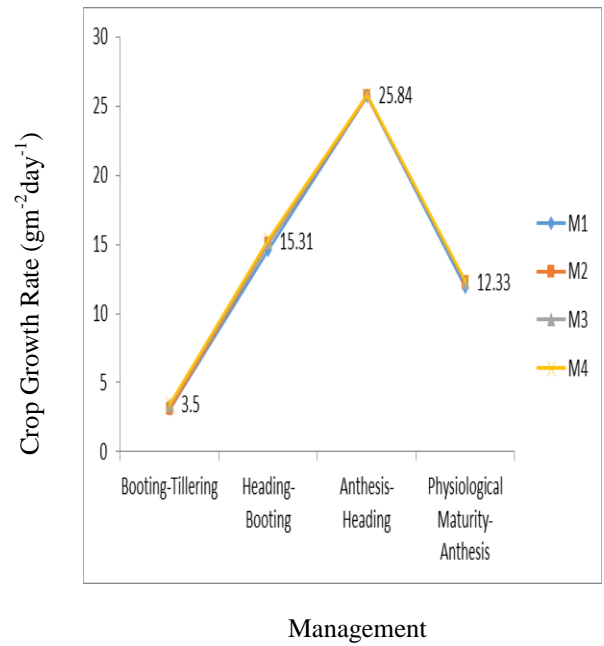
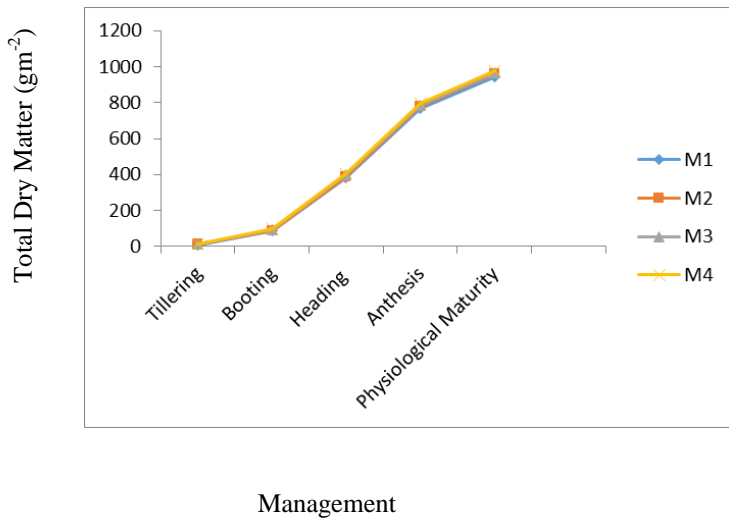


Figure 1a: Effect of nutrient management on Total Dry Matter (TDM) (gm<sup>-2</sup>) at different stages of wheat genotype

Figure 2a: Effect of nutrient management on Crop Growth Rate (CGR) (gm<sup>-2</sup>day<sup>-1</sup>) at different stages of wheat genotype

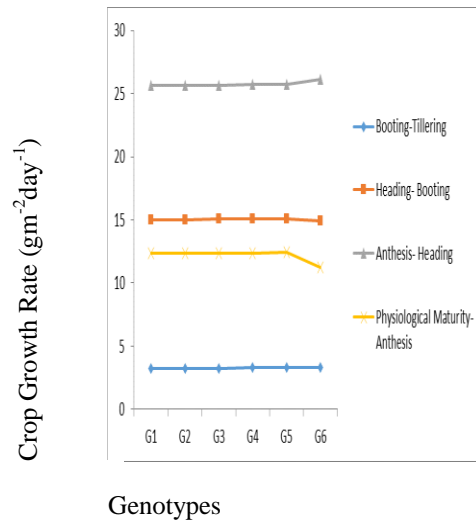
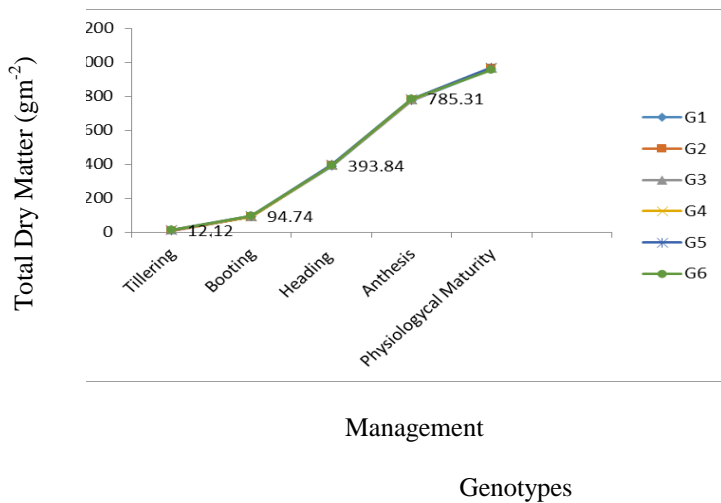


Figure 1b: Effect of genotypes on Total Dry Matter (TDM) (gm<sup>-2</sup>) at different stages of wheat genotype

Figure 2b: Effect of genotypes on Crop Growth Rate (CGR) (gm<sup>-2</sup>day<sup>-1</sup>) at different stages of wheat genotype

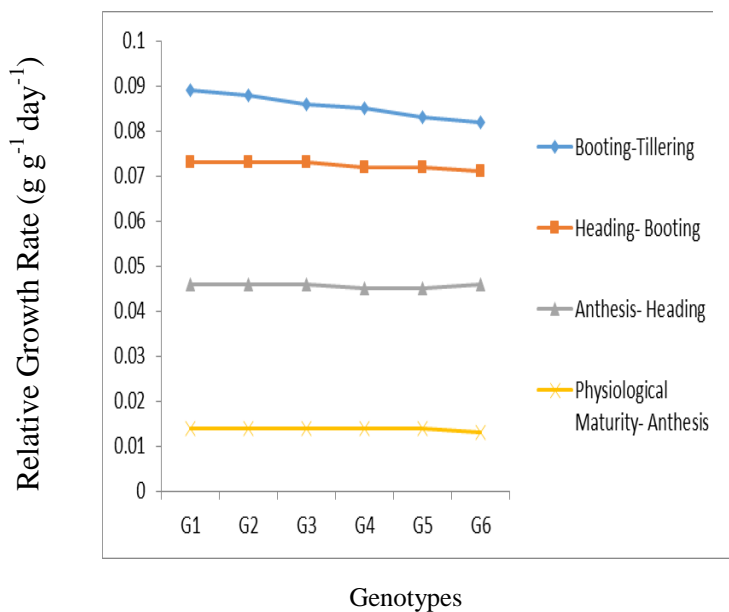


Figure 3: Effect of genotypes on Relative Growth Rate ( $g\ g^{-1}\ day^{-1}$ ) at different stages of wheat genotype

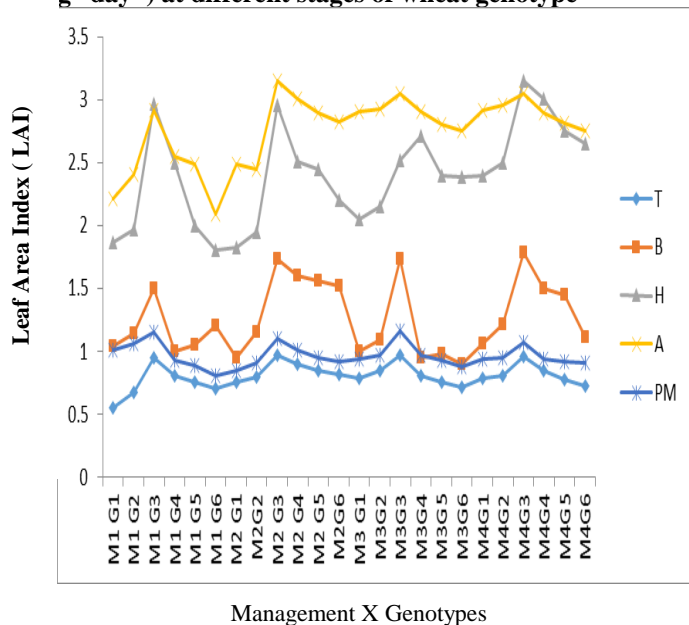


Figure 4. Interaction Effect of genotypes and nutrient management on Leaf Area Index at different stages of wheat genotype

CV= Co-efficient of variation

LSD= Level of significant Difference

M<sub>1</sub>= Recommended fertilizer

G<sub>1</sub>= BARI Gom 28

M<sub>2</sub>= 100% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

G<sub>2</sub>= BAW 1151 (BARI Gom 29)

M<sub>3</sub>= 150% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

G<sub>3</sub>= BAW 1161 (BARI Gom 30)

M<sub>4</sub>= 150% Recommended fertilizer plus 10 t ha<sup>-1</sup> cowdung (CD)

G<sub>4</sub>= BAW 1170

G<sub>5</sub>= BAW 1177

G<sub>6</sub>= BAW 1182

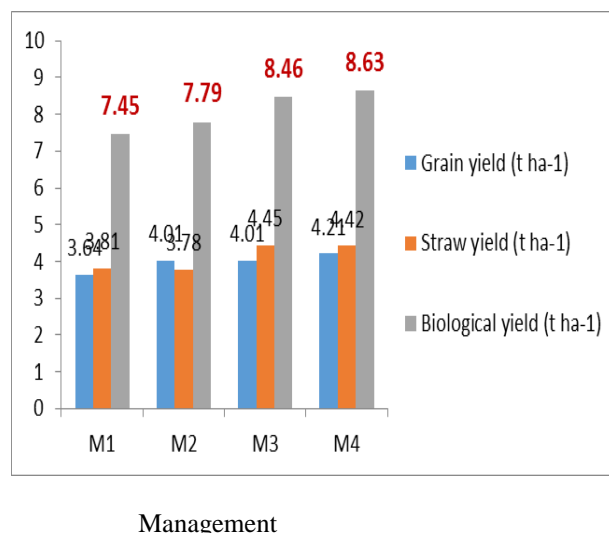


Figure 5a. Effect of nutrient management on yield of wheat genotype

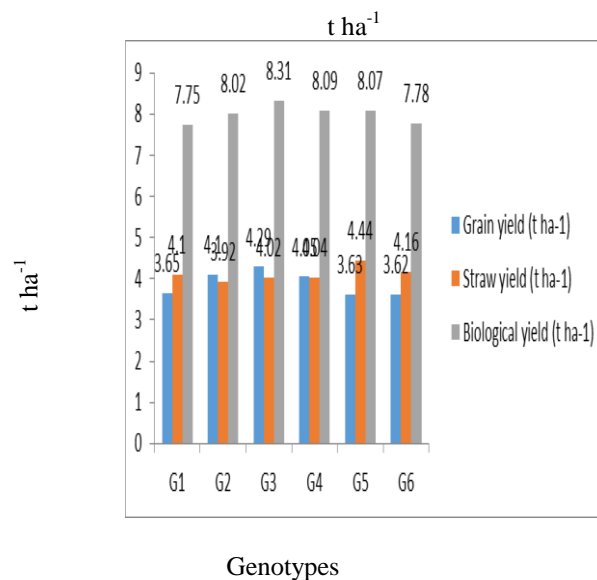


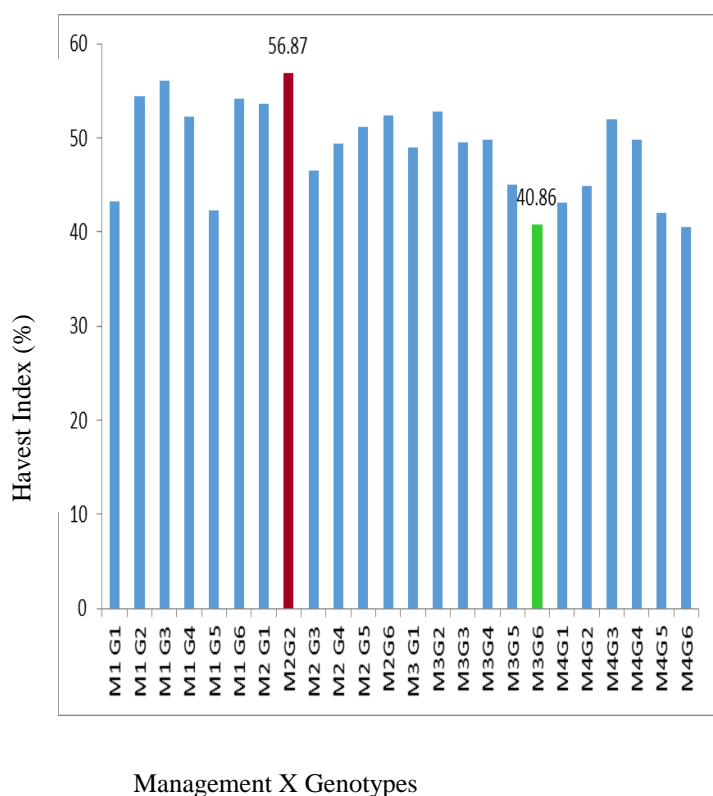
Figure 5b. Effect of genotypes on yield of wheat genotype

M<sub>1</sub>= Recommended fertilizer

M<sub>2</sub>= 100% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

M<sub>3</sub>= 150% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

M<sub>4</sub>= 150% Recommended fertilizer plus 10 t ha<sup>-1</sup> cowdung (CD)



**Figure 5c. Interaction effect of genotypes and nutrient management on harvest index**

M<sub>1</sub>= Recommended fertilizer

M<sub>2</sub>= 100% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

M<sub>3</sub>= 150% Recommended fertilizer plus 5 t ha<sup>-1</sup> cowdung (CD)

M<sub>4</sub>= 150% Recommended fertilizer plus 10 t ha<sup>-1</sup> cowdung (CD)

### 3.5.6 1000 grain weight (g)

#### Effect of nutrient management

1000 grain weight was not significantly affected by nutrient management. Numerically, the highest 1000 grain weight (43.32g) was observed M<sub>4</sub> and the lowest (39.74) from M<sub>2</sub> management (Table 3a)

#### Effect of genotypes

Genotypes had not significant effect on 1000-seed weight. G<sub>3</sub> gave the higher 1000 grain weight (43.45g) than G<sub>1</sub> (39.03g) (Table 3a).

#### Effect of interaction

There was no significant effect between nutrient management and genotypes combination on 1000-grain weight. It was varied from 36.58 to 46.58g (Table 3.b). Numerically, the highest 1000-grain weight (46.58 g) was obtained from the treatment combination of M<sub>4</sub>G<sub>3</sub> and the lowest 1000-grain weight (36.58 g) was obtained from the treatment combination of M<sub>1</sub>G<sub>3</sub>.

### 3.5.7 Grain yield (t ha<sup>-1</sup>)

#### Effect of nutrient management

Result showed that nutrient management had significant effect on grain yield at 5% level (Fig.5a). The highest grain yield (4.21 t ha<sup>-1</sup>) was observed in M<sub>4</sub> management. The lowest grain yield (3.64 t ha<sup>-1</sup>) was observed in M<sub>1</sub> management.

#### Effect of genotypes

Grain yield was varied significantly due to genotypes. The highest grain yield was obtained in G<sub>3</sub> (4.29 t ha<sup>-1</sup>) and lowest was (3.62 t ha<sup>-1</sup>) produced from G<sub>6</sub> (Fig. 5b).

#### Effect of interaction

The interaction of had significant effect at 5% level of significance on grain yield (Figure). The highest grain yield (4.60 t ha<sup>-1</sup>) was recorded in M<sub>4</sub>G<sub>3</sub> treatment and the lowest grain yield (3.05 t ha<sup>-1</sup>) was observed in in M<sub>1</sub>G<sub>1</sub> treatment (Table 3b). Chaudhry *et al.*, (2000) found highest wheat genotype grain and straw yield with NPK @ 120-90-60 Kg ha<sup>-1</sup> respectively.

### 3.5.8 Straw yield (t ha<sup>-1</sup>)

#### Effect of nutrient management

Straw yield weight was not significantly affected by nutrient management. Numerically, the highest straw yield (4.45 t ha<sup>-1</sup>) was observed in M<sub>3</sub> and the lowest (3.78 t ha<sup>-1</sup>) from M<sub>2</sub> management (Fig 5a)

#### Effect of genotypes

Straw yield was varied significantly due to genotypes (figure). The highest straw yield was obtained from G<sub>5</sub> (4.44 t ha<sup>-1</sup>) and lowest was (3.92 t ha<sup>-1</sup>) produced from G<sub>1</sub> (BARI Gom 28) (Fig 5b)

#### Effect of interaction

Straw yield was not statistically affected by the interaction of nutrient management and genotypes. The highest straw yield (4.81 t ha<sup>-1</sup>) was observed in M<sub>3</sub>G<sub>5</sub> treatment combination and the lowest straw yield (3.92 t ha<sup>-1</sup>) was obtained from M<sub>1</sub>G<sub>1</sub> treatment combination (Table 3b).

### 3.5.9 Biological yield (t ha<sup>-1</sup>)

#### Effect of nutrient management

Biological yield was not significantly influenced by nutrient management. The highest Biological yield (8.63 t ha<sup>-1</sup>) was observed in M<sub>4</sub> management. The lowest Biological yield (7.45 t ha<sup>-1</sup>) was observed in M<sub>1</sub> management (Fig 5a)

#### Effect of genotypes

The biological yield varied significantly due to genotypes. The highest biological yield (8.31 t ha<sup>-1</sup>) was produced by G<sub>3</sub> (BARI Gom 30) and the lowest biological yield (7.75 t ha<sup>-1</sup>) was produced by G<sub>1</sub> BARI Gom 28 (Fig 5b).

#### Effect of interaction

The interaction effect between nutrient management and genotype son biological yield was not statistically significant at 5% level of significance (Fig.5b). The highest biological yield (8.85 t ha<sup>-1</sup>) was obtained from M<sub>4</sub>G<sub>3</sub> treatment combination and the lowest biological yield (7.17 t ha<sup>-1</sup>) was resulted from M<sub>1</sub>G<sub>1</sub> treatment combination (Table 3b)

### 3.5.10 Harvest Index (%)

#### Effect of interaction

The harvest index was affected significantly the interaction between nutrient management and genotypes (Figure).



Numerically, the highest harvest index (56.87%) was found in M<sub>2</sub>G<sub>2</sub> treatment combination. The lowest harvest index (40.49%) was recorded from M<sub>4</sub>G<sub>6</sub> treatment combination (Table 5c)

### III. CONCLUSION

The present research was carried out at Regional Wheat Research Centre, BARI, Rajshahi. During the rabi season from November 2015 to April 2016 to study the effects of nutrient management and genotypes on yield, yield attributes and seed quality of wheat. In the main plot, 4 levels of soil management recommended fertilizer (N<sub>120</sub>P<sub>30</sub>K<sub>50</sub>S<sub>20</sub>), 100% of recommended fertilizer plus 5.0 t/ha cowdung, 150% of recommended fertilizer plus 5.0 t/ha cowdung, 150% of recommended fertilizer plus 10.0 t/ha cowdung with all the production package of WRC and six genotypes viz. BARI Gom 28, BAW 1151 (BARI Gom 29), BAW 1161 (BARI Gom 30), BAW 1170, BAW 1177 and BAW 1182. A split-split plot design was used for the experiment by assigning nutrient management to the main plot, genotypes to the sub-plots. The treatments were replicated three times. The total number of unit plots in the entire experimental area was 6×4×3 = 72. The size of the each sub-plot was 0.75 m. The experimental field was fertilized with above mentioned levels of nutrient management.

Seeds were sown on 30 November 2015 in 25 cm apart rows opened by specially made an iron hand tine. Data of yield and yield attributes were recorded after harvesting. The recorded data were compiled and tabulated for statistical analysis. The data were analyzed statistically and the mean differences among the treatments were adjudged by Duncan's Multiple Range Test (DMRT).

The overall objective of this study was to improve yield of wheat. Crop growth, growing periods, grain yield and all the yield components of wheat genotypes were affected by nutrient management. Application of NPKS in combination increased wheat yield. gave the highest grain yield (4.21 t ha<sup>-1</sup>) from M<sub>4</sub> management, due the higher number of Grains spike<sup>-1</sup> over nutrient management. The highest grain yield (4.29 t ha<sup>-1</sup>) was recorded from G<sub>3</sub> (BAW 1161) genotypes. Among the interaction of nutrient management and genotypes produced the highest grain yield (4.60 t ha<sup>-1</sup>) in M<sub>4</sub>G<sub>3</sub> (i.e 150% RF+10 t ha<sup>-1</sup> cow-dung) and BAW 1161 which may be considered as the best treatment combination.

Different genotypes showed variable response to nutrient management. To make maximum use of these wheat genotypes, they must be fertilized with high rates of nitrogen and phosphorus and irrigated adequately. They do not require more fertilizer but they are able to utilize more fertilizer efficiently. However, ongoing practice use modified soil fertility caused by nutrient management and other important elements thereby higher yield of wheat genotypes.

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