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Responses of Magic Growth on Growth and Yield of Wheat

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ABSTRACT

The experiment was conducted during the Rabi season from November 2017 to April 2018 to study the responses of magic growth on the growth and yield of wheat. The experiment was laid out in a randomized complete block design (RCBD) and comprised of two wheat varieties viz. Bijoy and Shatabdi with ten fertilization levels. Bijoy gave higher total dry matter (TDM), crop growth rate (CGR), leaf area index (LAI) and grain yield among the treatments, the higher TDM, CGR, LAI were obtained in the treatment T_9 (urea: 250 Kg ha^{-1} top dressing and modified magic growth: 1.2 L ha^{-1} magic growth + 1.2 Kg ha^{-1} urea + 0.8 Kg ha^{-1} MOP foliar treatment). The highest grain yield was found when the field was fertilized with T_9. So it could be concluded that Bijoy variety of wheat showed the maximum yield performance than Shatabdi with the application of (urea: 250 Kg ha^{-1} top dressing and modified magic growth: 1.2 L ha^{-1} magic growth + 1.2 Kg ha^{-1} urea + 0.8 Kg ha^{-1} MOP foliar treatment)

Key words: Bijoy, Growth, Magic growth, Shatabdi, Yield

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1. INTRODUCTION

Wheat (*Triticum aestivum* L.) is important nutritious cereal crop and most extensively cultivated crop throughout the world (Gao et al., 2014; Shewry, 2007). Achieving both high yield and grain quality is therefore a major goal in wheat production (Jalilian et al., 2012; Shi et al., 2010). In Bangladesh, it is the second most important staple food crop after rice (BBS, 2012). Wheat area estimate is forecast up to 340,000 ha. in 2019/20 and production is estimated at 1.15 MMT assuming favorable weather conditions. For 2018/19, post contacts believe that wheat area was down from the previous year due to the problem of wheat blast, unfavorable weather, and lower yield management. In 2019/20 (July-June), wheat imports are forecast at 6.3 MMT with an expectation of increased diversified use, consumers demand, and low international prices. In 2018/19, major wheat suppliers include Russia (43%), Ukraine (25%), Canada (14.6%), and the U.S. (13%). 2018/19 import forecast is down to 5.5 MMT based on strong international price. 2017/18 imports were revised to 6.4 MMT based on customs data. Wheat imports declined in 2018/19 due to a rise in international price as a result of decreased supply from exporting countries. The wheat consumption forecast is raised to 7.7 MMT in 2019/20, assuming more consumption of processed foods made from wheat flour. The consumption of wheat is increasing due to changing consumer behavior as a result of increased per capita income and improved socio-

economic conditions at the household level in urban areas. With increased industrialization and associated labor in urban areas, consumption of processed confectionaries has increased significantly. Because of increased market demand, newer brand and non-brand processed food industries are setting up in urban and peri-urban areas, thereby gradually increasing demand for wheat flour (Mottaleb et al., 2019).

Agriculturists said rising acreage and production might cut Bangladesh's import costs for the grain, the demand for which grows every year owing to rising population, health consciousness and industrial use. The country needs 40 lakh tonnes of wheat, two-thirds of which are imported every year.

It is essential to develop and introduce new wheat seed varieties that contain high protein and have better yielding capacity; farmers will get higher prices for growing wheat with high levels of protein. It will also reduce our import dependence, said Anup Kumar Saha, business director of ACI Ltd. (Parvez, 2015). The growth and yield of wheat increased with the foliar application of various fertilizers. The foliar application of nutrients is more effective as compared to soil applied nutrients because of effective utilization by plant and minimum cost per unit area (Narang et al., 1997). Plant nutrient solution sprayed on plant foliage can be quickly absorbed. So foliar spray of these elements is the best method of fertilizer application to control their losses from the soil and make them more and easily available to the plant and in turn increase the yield and quality of wheat grain (Zhiguleve, 1992).The yield of high yielding varieties generally increases by increasing level of nitrogen (Behera *et al.,* 2000; Woyema et al., 2012). The investigation was therefore, undertaken to investigate the effect of foliar application of magic growth on plant growth and yield of wheat Bijoy and Shatabdi.

2. MATERIALS AND METHODS

The research work was carried out at the Agronomy Field Laboratory, Department of Agronomy and Agricultural Extension, University of Rajshahi during the period from November 2017 to April 2018 to study the performance of liquid fertilizer on growth and yield of wheat.

The experimental field was a high land with sandy loam textured soil having pH value of 8.10. The top soil was sandy loam and slightly alkaline in reaction. The climate in and around the experimental field belong to Agro-Ecological Zones (AEZ)-11, was tropical monsoon accompanied by distinct season. This area is characterized by calcareous soil containing large amount of $CaCO_3$ and also high concentration of available Ca^{2+} in that soil (BBS, 1996). But less availability of other macro and micro nutrients which are essential for successful growth and development of wheat plant.

In these experiment seeds of wheat varieties i.e. Bijoy (BARI Gom 23) and Shatabdi (BARI Gom 21) were used as the planting material collected from Regional Wheat Research Station, Shyampur, Rajshahi. In the present experiment, variety and liquid fertilizer (magic growth or its modified form) treatments were evaluated in the growth and yield performance.

As wheat variety, Bijoy and Shatabdi were used. The fertilizer treatments were used in this experiment, showed in Table 1.

The experiment was laid out in a randomized complete block design (RCBD) with three replications. For each variety, every block was divided into ten plots. The total number of unit plots in the entire experimental plot was 60 (2 varieties ×10 fertilizer treatments × 3 replication). The unit plot size was 2 m × 2 m. The plot to plot distance was 0.5 m and the block to block distance was 1.0 m.

The fertilizers used as a general dose in the experimental plots were: 135 kg ha^{-1} TSP, 98 kg ha^{-1} MOP, 113 kg ha^{-1} gypsum and 7.5 kg ha^{-1} boric acid. The whole amount of TSP, MOP, gypsum and boric acid were applied during the land preparation without urea. Urea was applied as top dressing in the time of cultivation. The first split of urea was applied just before the seed sowing. The second split of urea

Table 1: Fertilizer treatments applied during cultivation of wheat variety Bijoy and Shatabdi.

Treatments	Top dressing (urea kg ha^{-1})				Foliar application	
	Total	Split 1	Split 2	Split 3	(MMG) L ha^{-1}	(MG) L ha^{-1}
T_1 (Control)	-	-	-	-	-	-
T_2	150	88	62	-	-	-
T_3	150	88	62	-	*	-
T_4	175	75	62	38	-	-
T_5	175	75	62	38	*	-
T_6	225	88	75	62	-	-
T_7	225	88	75	62	*	-
T_8	250	88	86	76	-	-
T_9	250	88	86	76	*	-
T_{10}	250	88	86	76	-	**

(-) no fertilizer application.

* Modified magic growth (MMG) = 1.2 L ha^{-1} magic growth + 1.2 Kg ha^{-1} urea + 0.8 Kg ha^{-1} MOP mixed with 400L water.

** Magic growth (MG) = 1.2 L ha^{-1} magic growth mixed with 400 L water.

was also top dressing which was applied during first irrigation (CRI stage, after 20 days of seed sowing) and the third split of urea as top dressing applied at second irrigation (after 55 days of seed sowing). Splits of urea application showed in Table 1.

Liquid fertilizers i.e. magic growth (Table 2) and modified magic growth (1.2 L ha^{-1} magic growth + 1.2 Kg ha^{-1} urea + 0.8 Kg ha^{-1} MOP mixed with 400 L water) was sprayed three times viz. 1st time at 35 days after seed sowing (jointing stage), 2nd time at 55 days after seed sowing (booting stage) and 3rd time at 75 days after seed sowing (flowering stage). Modified magic growth was involved in T_3, T_5, T_7 and T_9 treatments and magic growth was involved in T_{10} only (Table 1). Spray was done in afternoon to avoid sun burn.

Table 2. Chemical composition of magic growth.

Elements	Amount (%)
Total Nitrogen (N)	10.51
Phosphorus (P)	5.58
Potassium (K)	6.33
Sulphur (S)	0.10
Zinc (Zn)	0.16
Copper (Cu)	0.04
Iron (Fe)	0.0006
Manganese (Mn)	0.006
Boron (B)	0.25
Calcium (Ca)	0.07
Magnesium (Mg)	0.007
pH	1.0

Magic Growth is a liquid fertilizer invented by Md. Arif Hossain Khan, Joint Director (Seed Marketing), Bangladesh Agricultural Development Corporation (BADC) which is ready for government recognition

The collected data were analyzed statistically using the statistical package "MSTAT-C". The mean differences were adjudged by Duncan's Multiple Range Test.

3. RESULTS AND DISCUSSION

Effect of variety

Variety had significant effect on total dry matter (TDM), crop growth rate (CGR), leaf area index (LAI) and grain yield with a few exceptions. Bijoy produce the higher TDM at 35, 55, 75 days after sowing (DAS) than Shatabdi (Fig 1). The maximum CGR were found in the variety Bijoy in different days after sowing (Fig 2). The result was supported by Nadim et al. (2011). From the result it was observed that LAI differed with the variety of wheat at 35, 55 and 75 DAS (except 95 DAS), the higher LAI was observed in variety Bijoy and lowest in Shatabdi(Fig 3). Among two varieties, Bijoy produced maximum grain than Shatabdi (Table 3).These results may be due to the expression of genetic makeup Pandey (2002) reported that the grain yield differed among the varieties.

Effect of magic growth liquid fertilizer

TDM production of wheat was significantly influenced by the application of liquid fertilizer at different days after sowing (Hasina et al., 2011). From (Table 4) it was observed that, TDM production increased with the application of magic growth. At 35 DAS, T_9 showed the highest TDM (1.485 g) whereas, T_1 (Control) showed the lowest TDM (0.618 g). After application of liquid fertilizer a tremendous change take place. At 55 DAS, T_9 produces the highest TDM (4.488 g) whereas; T_1 produces the lowest TDM (1.937 g). After 55 DAS, a similar pattern in producing TDM was observed up to 95 DAS i.e. at all observation T_9 showed the highest TDM and T_1 showed the lowest TDM. Due to application of magic growth, crop growth rate influenced significantly at 1% level of probability at all the growth intervals. From the results, it was observed that from all the intervals of DAS crop growth rate was highest in T_9 treatment and lowest in T_1 treatment. The highest crop growth rate (15.017 g m^{-2} day^{-1}) was observed in T_9 treatment and the lowest crop growth rate (6.592 g m^{-2} day^{-1}) was observed in T_1 treatment during the period of 35-55 DAS. During the period of 55-75 DAS, the highest crop growth rate (48.700 g m^{-2} day^{-1}) was observed in T_9 treatment and the lowest crop growth rate (30.600 g m^{-2} day^{-1}) was observed in T_1 treatment. Finally during the period of 75-95 DAS, the highest CGR (32.492 g m^{-2} day^{-1}) was also observed in T_9 treatment and the lowest CGR (14.808 g m^{-2} day^{-1}) was also observed in T_1 treatment. From the results, it was also observed that, T_{10} treatment produced the second highest CGR at the intervals of 35-55, 55-75 and 75-95 DAS, which value was statistically identical with that of T_9 (Table 4). Magic growth had significant influence on leaf area index at all the sampling dates. From the result it was observed that LAI increased with the application of liquid fertilizer. LAI increases with the increase of time up to 75 DAS and thereafter decline at 95 DAS. After 75 DAS, the basal leaves became dry which resulted in decreased leaf area at maturity of plants. However at 35 DAS before the application of liquid fertilizer the highest LAI (2.293) was observed in T_9 treatment and the lowest LAI (0.566) was observed in T_1 treatment. Finally, at 95 DAS T_9 showed highest result (2.617) and T_4 produces lowest (1.758). Thus it is observed that, magic growth exerted a significant influence on LAI. The higher will be the LAI, the more will be the yield (Table 4). Grain yield of wheat responded significantly due to magic growth. The grain yield varied from 2.133 to 4.651 t ha^{-1}. The highest grain yield (4.651 t ha^{-1}) was obtained from the treatment T_9 and the lowest grain yield (2.133 t ha^{-1}) was obtained from the control dose T_1. Whereas, second highest grain yield (4.118 t ha^{-1}) was recorded from the T_{10} (Table 4). Results obtained in this study showed that, grain yield increased with the application of liquid fertilizer (Tayebeh et al., 2010). In control T_1, the growth and development of plants hampered due to imbalance uptake of essential elements which ultimately

Table 3: Effect of variety on total dry matter (TDM), crop growth rate (CGR), leaf area index (LAI) at different days after sowing (DAS) and Grain Yield of wheat.

Variety	TDM (g plant^{-1}) at different days after sowing (DAS)				CGR (g m^{-2}day^{-1}) at different days after sowing (DAS)			LAI at different days after sowing (DAS)				Grain yield (t ha^{-1})
	35	55	75	95	35-55	55-75	75-95	35	55	75	95	
Bijoy (V_1)	1.24a	3.49a	11.44a	15.99	11.27	39.75a	24.79a	1.52a	2.51a	4.06a	2.29	3.63a
Shatabdi (V_2)	0.89b	3.18b	10.80b	15.76	11.46	38.08b	22.75b	1.37b	2.44b	3.94b	2.22	3.37b
Significance	0.01	0.01	0.01	NS	NS	0.05	0.05	0.01	0.05	0.05	NS	0.01
CV (%)	5.11	6.22	4.82	5.31	9.28	7.20	12.64	11.64	4.54	5.24	7.11	4.19

In a column, means followed by a similar letter(s) or without letter are not significantly different whereas, means followed by a dissimilar letter(s) are significantly different as per DMRT.
CV = Co-efficient of variation; DAS = Days after sowing; NS = Non-significant.

Table 4. Effect of magic growth liquid fertilizer on total dry matter (TDM), crop growth rate (CGR), leaf area index (LAI) at different days after sowing (DAS) and Grain Yield of wheat.

Treatments	TDM (g plant^{-1}) at different days after sowing (DAS)				CGR (g m^{-2}day^{-1}) at different days after sowing (DAS)			LAI at different days after sowing (DAS)				Grain yield (t ha^{-1})
	35	55	75	95	35-55	55-75	75-95	35	55	75	95	
T_1	0.61i	1.93f	8.05f	11.01f	6.59e	30.60c	14.80d	0.56g	1.45g	3.35e	1.87de	2.13h
T_2	0.81h	2.44e	9.94e	14.14e	8.19de	37.48b	21.00c	0.78fg	1.54g	3.47e	1.93de	2.56g
T_3	0.89g	2.75de	10.06de	14.59de	9.29d	36.53b	22.68c	1.00ef	2.15e	3.67dc	2.08cd	2.91f
T_4	0.97fg	2.90d	10.39de	16.02c	9.63d	37.45b	28.13ab	1.13de	1.86f	3.65dc	1.75e	3.25e
T_5	1.04ef	3.35c	10.62cde	15.43cde	11.59c	36.31b	24.07bc	1.32d	2.05e	3.82cd	2.53ab	3.70d
T_6	1.11de	3.50c	10.92cd	15.90cd	11.96bc	37.09b	24.90bc	1.61c	2.41d	3.99cd	2.27bc	3.80cd
T_7	1.17cd	3.83b	11.35bc	16.17c	13.32ab	37.59b	24.10bc	1.76bc	2.85c	4.06bc	2.48ab	3.86cd
T_8	1.24c	4.05b	12.14b	16.60c	14.04a	40.45b	22.29c	1.99b	3.33b	4.36b	2.40ab	4.03bc
T_9	1.48a	4.48a	14.22a	20.72a	15.01a	48.70a	32.49a	2.29a	3.88a	4.89a	2.61a	4.65a
T_{10}	1.34b	4.15b	13.54a	18.19b	14.04a	46.95a	23.24bc	1.99b	3.21b	4.73a	2.61a	4.11b
Significance	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CV (%)	5.11	6.22	4.82	5.31	9.28	7.20	12.64	11.64	4.54	5.24	7.11	4.19

In a column, means followed by a dissimilar letter(s) are significantly different as per DMRT.

CV = Co-efficient of variation; DAS = Days after sowing;
T_1 - T_{10} = Different treatments showing in Table-1.

Table 5. Interaction effect of variety and magic growth liquid fertilizer on total dry matter (TDM), crop growth rate (CGR), leaf area index (LAI) at different days after sowing (DAS) and grain yield of wheat.

Interaction	TDM (g plant^{-1}) at different days after sowing (DAS)				CGR (g m^{-2}day^{-1}) at different days after sowing (DAS)			LAI at different days after sowing (DAS)				Grain yield (t ha^{-1})
	35	55	75	95	35-55	55-75	75-95	35	55	75	95	
V_1T_1	0.72	1.90	9.78h	12.55	5.91h	39.40b-e	13.81g	0.59h	1.46	3.76fgh	1.78fg	2.30
V_1T_2	0.87	2.68	9.89gh	13.67	9.05fg	36.05cde	18.88efg	0.77fg	1.59	3.72fgh	1.88f	2.86
V_1T_3	0.96	2.84	9.89gh	14.17	9.38f	35.23cde	21.40c-f	1.06f	2.54	3.91e-h	2.27a-e	2.93
V_1T_4	1.12	3.12	9.90gh	15.69	10.03ef	33.88de	28.94abc	1.23ef	1.93	3.91e-h	2.02c-f	3.40
V_1T_5	1.20	3.49	10.25fgh	14.41	11.46de	33.76e	20.80d-g	1.49de	2.12	3.93efg	2.44ab	3.83
V_1T_6	1.35	3.71	10.83e-h	15.76	11.80de	35.60cde	24.63b-e	1.73de	2.32	4.03def	2.40abc	3.86
V_1T_7	1.46	3.81	11.18c-g	15.42	11.75de	36.86cde	21.21def	1.92de	2.67	3.83e-h	2.46 ab	3.90
V_1T_8	1.46	4.18	12.30bc	17.44	13.61bc	40.56b-e	25.70b-e	2.02ab	2.82	4.22def	2.43ab	4.13
V_1T_9	1.72	4.85	15.54a	22.32	15.68a	53.41a	33.93a	2.38a	3.83	4.76abc	2.60a	4.86
V_1T_{10}	1.55	4.35	14.90a	18.54	14.00ab	52.73a	18.21efg	2.00bc	3.11	4.52bcd	2.63a	4.20
V_2T_1	0.51	1.96	6.32i	9.487	7.26gh	21.80f	15.80fg	0.54gh	1.44	2.93j	1.96ef	1.96
V_2T_2	0.74	2.21	9.99gh	14.62	7.33gh	38.91b-e	23.11c-f	0.78gh	1.50	3.21ij	1.98def	2.26
V_2T_3	0.82	2.66	10.23fgh	15.02	9.20f	37.83b-e	23.96b-e	0.94f	1.76	3.43ghi	1.89ef	2.90
V_2T_4	0.83	2.68	10.88d-h	16.35	9.23f	41.03bcd	27.31a-d	1.03f	1.78	3.40hij	1.49g	3.10
V_2T_5	0.87	3.22	10.99c-h	16.46	11.71de	38.86b-e	27.35a-d	1.15de	1.98	3.71fgh	2.63a	3.56
V_2T_6	0.87	3.30	11.01c-h	16.05	12.13cd	38.58b-e	25.18b-e	1.48cd	2.51	3.96ef	2.15b-f	3.73
V_2T_7	0.88	3.86	11.52c-f	16.92	14.90ab	38.31b-e	27.00a-d	1.61ab	3.02	4.30cde	2.49ab	3.83
V_2T_8	1.03	3.92	11.99b-e	15.76	14.46ab	40.33b-e	18.88efg	1.96ab	3.83	4.51bcd	2.36a-d	3.93
V_2T_9	1.25	4.12	12.91b	19.12	14.35ab	43.98b	31.05ab	2.20ab	3.93	5.02 a	2.62a	4.43
V_2T_{10}	1.12	3.94	12.18bcd	17.83	14.08ab	41.18bc	28.26a-d	1.98ab	3.31	4.94ab	2.59a	4.03
Significance	NS	NS	0.05	NS	0.05	0.01	0.01	0.01	NS	0.01	0.01	NS
CV (%)	4.87	4.98	4.41	4.16	9.28	7.20	12.64	5.11	6.22	4.82	5.31	4.19

In a column, means followed by a similar letter(s) or without letter are not significantly different whereas, means followed by a dissimilar letter(s) are significantly different as per DMRT.

CV = Co-efficient of variation; DAS = Days after sowing; NS = Non-significant; V_1 = Bijoy, V_2=Shatabdi ; T_1 - T_{10} = Different treatments showing in Table-1.

resulted in poor performance of yield (Dandan & Yan, 2013). Magic growth liquid fertilizer positively affect on the yield and nutrient content of Aman rice cultivars (Rabin et al., 2016).

Interaction effect

The interaction of variety and fertilizer had significant effect of CGR and LAI except TDM at different DAS. The interaction between V_1 x T_9 produced the higher CGR and LAI which was statistically similar to V_1 x T_{10} and V_2 x T_9 with a few exceptions. The interaction had no significant effect on grain yield. These results are in close agreement with those of Rogalski (1994).

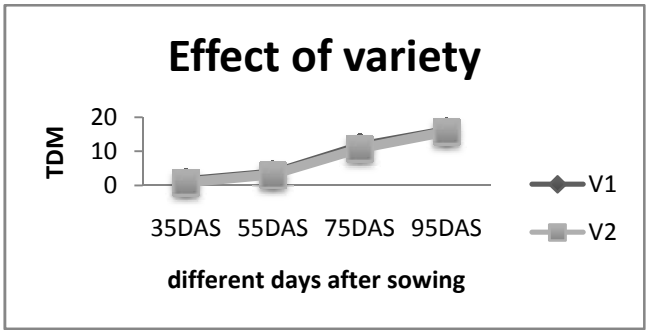

Fig 1: Effect of variety on total dry matter (TDM) at different days after sowing (DAS) of wheat.

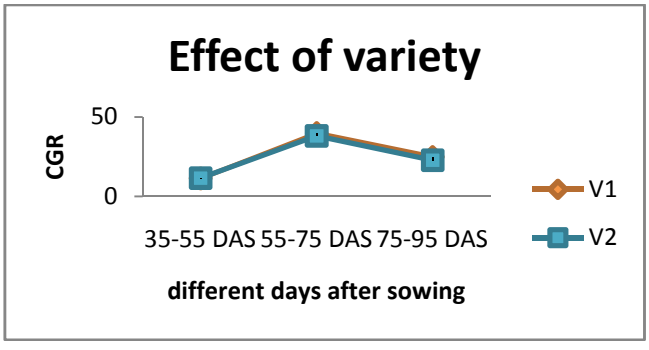

Fig 2: Effect of variety on crop growth rate (CGR) at different days after sowing (DAS) of wheat.

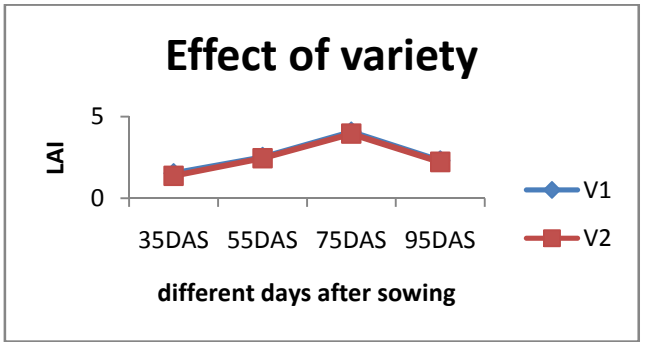

Fig 3: Effect of variety on leaf area index (LAI) at different days after sowing (DAS) of wheat.

4. CONCLUSION

Based on the result of the present study, it can be concluded that T_9 treatment (including foliar application by modified magic growth: 1.2 L ha^{-1} magic growth + 1.2 Kg ha^{-1} urea + 0.8 Kg ha^{-1} MOP mixed with 400 L water) treatment was the optimum fertilization for profitable cultivation of wheat. On the other hand, in case of urea abundance, spraying of additional urea can be avoided by spraying magic growth: (1.2 L ha^{-1} magic growth mixed with 400L water) as in T_{10}.Thus, in order to increase production the farmers can be suggested to use liquid fertilizer for maximizing yield of wheat so that, they as well as the whole nation will be benefited.

5. REFERENCES

BBS, (2012). *Statistical Yearbook of Bangladesh, Bangladesh Bureau of Statistics.* Statistics & Informatics Division, Ministry of Planning, Government of the People's Republic of Bangladesh, Dhaka, pp.139.

BBS, (1996). *Agriculture Census*: *The Bangladesh Census of Agriculture and Livestock, Bangladesh Bureau of Statistics*. Ministry of Planning, Government of the People's Republic of Bangladesh.

Behera, U. K., Chougule, B. A., Thakur, R. S., Ruwali, K. N., Bhawsar, R. C. & Pandey, H. N. (2000). Influence of planting dates and nitrogen levels on yield and quality of durum wheat (*Triticum durum*). *Indian J. Agric. Sci*., 70, 434–6.

Dandan, L. & Yan, S. (2013). Effects of different nitrogen fertilizer on quality and yield in winter wheat. *Adv. J. of Food Sci. Tech.,* 5(5), 646-649.

Gao, Y., Wu, P. T., Zhao, X. N. & Wang, Z. K., (2014). Growth, yield, and nitrogen use in the wheat/maize intercropping system in an arid region of northwestern China. *Field Crops Research,* 167, 19–30.

Hasina, G., Ahmad, S., Beena, S., Fida, M. & Ijaz, A. (2011). Effect of foliar application of nitrogen, potassium and zinc on wheat growth. *J. Agric. Bio. Sci., 6(4), 56-58.*

Jalilian, J., Modarres-Sanavy, S. A. M., Saberali, S. F. & Sadat-Asilan, K. (2012). Effects of the combination of beneficial microbes and nitrogen on sunflower seed yields and seed quality traits under different irrigation regimes. *Field Crops Research,* 127, 26–34.

Mottaleb, K. A., Singh, P. K., He, X., Hossain, A., Kruseman, G., Erenstein, O. (2019) Alternative use of wheat land to implement a potential wheat holiday as wheat blast control: In search of feasible crops in Bangladesh, *Land Use Policy*, 82, 1-12.

Nadim, M. A., Awan, U. I., Baloch, M. S., Khan, E. A., Naveed, K., Khan, M. A., Zubair, M. & Hussain, N. (2011). Effect of micronutrients on growth and yield of wheat. *Pak. J. Agric. Sci.,* 48 (3), 191-196.

Narang, R. S., Mahal, S. S., Bedi Seema, Gosal, K. S. & Bedi, S. (1997). Response of wheat to potassium

fertilization under maximum yield research strategies. *Env. Eco.,* 15(2), 474-477.

Parvez, S. (2015). Wheat production highest in 11 years. The daily Star, 08 March, pp. 2.

Pandey, J., Verma, A. K. & Pandey, J. (2002). Effect of atrazine, metribuzin, sulfosulfuron and tralkoxydim on weeds and yield of wheat (*Triticum aestivum*). *Ind. J. Agron*., 47(1), 72-76.

Rabin, M. H., Razzaque, M. A., Zamil, S. S., Ashraf-Uz-Zamman, K. & Siddik, M. A. (2016). Foliar application of urea and magic growth liquid fertilizer on the yield and nutrient content of aman rice cultivars. *American-Eurasian J. Agric. & Environ. Sci.,* 16(4), 737-743.

Rogalski, L. (1994). Influence of supplementary foliar spray nutrition with plant protection on yield of winter wheat. *Acta Acedemiae Agriculture Technicae Olsteninsis, Agric.,* 57, 111-118.

Shewry, P. R. (2007). Improving the protein content and composition of cereal grain, *Journal of Cereal Science*, 46, 239-250.

Shi, R., Zhang, Y., Chen, X., Sun, Q., Zhang, F., Roemheld, V., Zou, C. (2010). Influence of long-term nitrogen fertilization on micronutrient density in grain of winter wheat (*Triticum aestivum* L.). *Journal of Cereal Science,* 51, 165–170.

Tayebeh, A., Abass, A. & Seyed, A. K. (2010). Effect of organic and inorganic fertilizers on grain yield and protein banding pattern of wheat. *Australian journal of crop science,* 4(6), 384-389.

Woyema, A., Bultosa, G. & Taa, A. (2012). Effect of different nitrogen fertilizer rates on yield and yield related traits for seven durum wheat (*Triticum turgidum* L. Var *Durum*) cultivars grown at sinana. *African Journal of Food, Agriculture, Nutrition and Development,* 12(3), 6079-6094.

Zhigulev, A. K. (1992). Effect of foliar application of nitrogen fertilizer on yield and quality of winter wheat grain. *Agrokhemiya,* 3, 3-9.