Publisher homepage: www.universepg.com, ISSN: 2663-6913 (Online) & 2663-6905 (Print)

https://doi.org/10.34104/ajpab.022.01030114

American Journal of Pure and Applied Biosciences

Journal homepage: www.universepg.com/journal/ajpab

Effect of Hill Temperature on Wheat Variety Development and Yield in the District of Khagrachari

Mohammad Ahsan Ali[1]*, Mohammad Muktadir Alam[2], Mohammad Tofajjal Hossain[2], Mohammad Rabiul Islam[2], Mohammad Afzal Hossain[3], Mohammad Shamsul Huda[4], and Md Nazmul Haque[5]

[1]Bangladesh Wheat and Maize Research Institute, BWMRI, Gazipur-1701, Bangladesh; [2]Regional Agricultural Research Station, RARS, Hathazari, Chattogram-4300, Bangladesh; [3]Bangladesh Rice Research Institute, BRRI, Gazipur-1701, Bangladesh; [4]Agricultural Research Station, ARS, BARI, Dinajpur-5200, Bangladesh; and [5]Caritas Bangladesh, 2, Outer Circular Road, Shanti Bagh, Dhaka-1217, Bangladesh.

*Correspondence: aahathazari@gmail.com (Mohammad Ahsan Ali, Regional Station, Bangladesh Wheat and Maize Research Institute, BWMRI, Gazipur-1701, Bangladesh).

ABSTRACT

The experiment which likened the execution of high-placed outcome briefly cold duration and heat-tolerant varieties under increasing temperature was carried out in two successive crop seasons (2017-18 and 2018-19) at a farmer's field in Maniksari Upzila within Khagrachari Hill District during the Rabi season (November–March). Early mature wheat types made available by BARI were sown at the ideal time and were heat, saline tolerant as a coping strategy for extreme heat stress. There were six short time wheat cultivars developed recently in heat and stress (BARI Gom 25, BARI Gom 28, BARI Gom 30, BARI Gom 32, BARI Gom 33 and Advance Line BAW 1147). BARI Gom 33 (3.86 t/ha and 3.80 t/ha) and BARI Gom 30 (3.78 t/ha and 3.56 t/ha) produced the highest crop yields over the course of a few years. BARI Gom 32 (3.00 t/ha and 3.40 t/ha), Advance line 1147 (2.96 t/ha and 3.04 t/ha) and BARI Gom 28 (2.59 t/ha and 3.10 t/ha) were found the highest yields. BARI Gom 25 (2.74 t/ha and 2.89 t/ha) had the lowest yield. The quantity of biomass yield and wheat crop output differed significantly, but the other characteristics had little bearing. BARI Gom 25 was the earliest maturing variety, and BARI Gom 33 generated the highest crop output compared to other varieties. The highest benefit cost ratio (BCR) was 1.48 displayed by BARI Gom 33 and the lowest by BARI Gom 25 which was 1.08. According to the experiment's findings, BARI Gom 33 was among the six kinds in the Khagrachari Hills' early high producing and most adaptable variety. BARI Gom 30 also may be cultivated in the Khagrachari hills District.

Keywords: Stress tolerant, Adapted variety, High wheat yield, Wheat variety, and Khagrachari hills.

INTRODUCTION:

One of the important significant food sources of carbs, proteins, fiber, amino acids and vitamins is wheat (*Triticum aestivum L.*), which accounts for 25% of world's cereal production. It also provides 20% of daily calories and 25% of the protein consumed world-wide (FAO FAOSTAT, 2019). The only cereal crop most affected by rising average temperatures during the wheat growing seasons is wheat (Semenov *et al*., 2011; Teixeira *et al*., 2013). The greater portion great second kernel crop in Bangladesh is wheat, which has a direct impact on the nation's economic and food security. High grain production, good nutrients, pro-cessing quality and temperature tolerance in good wheat lines that can with stand biotic and abiotic stress (Mondal *et al*., 2016). A propos to secure food security, utter temperature oppression is necessary. For every degree Celsius increase, the output of wheat decreases by 4.1 to 6.4 percent (Liu *et al*., 2016). According to the discussion in high temperatures affect some yield metrics such as incipient weight and grain amount and weight (Akter *et al*., 2017). Particularly between spike initiation and anthesis, a large heat has an impact on grain number (Farook *et al*., 2011). High temperatures after anthesis diminish grain mass, especially if the treatment is started early (Gibson *et al*., 1994; Castro *et al*., 2007). Heat stress shortens the time grains fill up, as described in (Altenbach *et al*., 2012). When grains are filled at temperatures above 30°C, starch implication enzymes are less able to move through the grains, further lowering the amount of starch present (Hurkman *et al*., 2003; Corbellini *et al*., 1998). At present our country need about 65 lac MT wheat for mitigations of demand but our domestic output is respecting 12 lac MT that why we have to span valuable foreign currencies. Due consideration must be given to raising domestic wheat production by increasing wheat cultivation in non-traditional regions of the nation where cropping intensity is low and there are opportunities for wheat development. One tenth of the country or the Hill Tract regions are made up of 75% upland (hills), 20% undulating bumpy ground and 5% valley plain land (Ataur *et al*., 2015). Due to a lack of irrigation water needed for boro rice farming a vast bumpy undulating area and the valleys are left fallow in the winter. Wheat can be adult in the majority of areas with the narrow water capital that are there because its water consumption is less than one-fourth that of rice. Since the winter pattern and duration at the hill are different, the wheat's sowing date may be changed in an effort to maximize environmental benefits. In order to encourage the development of the promising cultivars in hill regions, disparities in varietal adoption may also exist. Following some articles (Rahman *et al*., 2013; Tang *et al*., 2003; Rahman *et al*., 2005) air temperatures, management practices (Rahman *et al*., 2002; Timsina and Cornor, 2001), and soil type, wheat variety yield performance varied. In response to changes in environmental conditions and elevation in the hill region, there may be varietal differences. It is possible to classify as adaptable in hilly areas the wheat types that yield more at the greater elevation of Khagrachuri. With the ultimate goal of expanding wheat in Bangladesh's non-traditional hill valleys, the current experiment preparation look at how different varieties responded to higher elevation and condition best seeding technique for that area.

MATERIALS AND METHODS:

Experimental Soil Types

The experimental field's soils were severely acidic (pH 5 - 5.2), with greater concentrations of Fe, Al, and Mn in the top 15 cm of soil and deficiencies in several vital plant nutrients such nitrogen (Total N = 0.07%-0.09%), phosphorus (Olsen P = 5.6 - 6.4 ppm), and potassium (K = 0.18 - 0.22 meq/100g). Sulfur and zinc levels in the soil were high, but the crucial boron content was deficient. **Table 2** shows the physical and chemical data of the ground prior to conducting the experiment. Data gathered from locally agricultural offices in Khagrachari hill districts.

Table 1: Physical and chemical data of the first soil achieve from the top layer are listed in (0-15 cm).

Khagrachari (Manik sari, Upzila) Season	Particle Density(g cm^{-3})	Bulk Density (g cm^{-3})	Porosity (%)	Soil Moisture of Field Capacity	Soil Moisture of Sowing (%)	Textural Class
2017-18	2.43	1.47	42.77	28.18	21.08	Clay Loan
2018-19	2.39	1.45	42.76	28.17	21.09	Clay Loan

Table 2: Nutrient substances of initial soil collected from surface layer (0-15 cm).

Chemical Properties	P^h	OM	Total N (%)	P	S	B	Zn	Cu	Fe	Mn	K	Ca	Mg
				$100g^{-1}$	μg g^{-1}								
2017-18 (Khagrachari)	5.1	1.09	0.07	5.6	36	0.17	3.7	3.2	108	16	0.18	4.6	2.1
2018-19 (Khagrachari)	5.2	0.99	0.09	6.4	41	0.15	4.2	3.2	98	16	0.22	5.1	2.1
Critical level	-	-	-	7	14	0.20	2.0	1.0	10	5	0.20	2.0	0.8

Weather condition of experimental location

In Maniksari Upzila under Khagrachari in the years 2017 - 18 and 2018 - 19, an experiment was conducted during the Rabi season. Khagrachari is located at latitude 23.14"N and longitude 91.95"E. (November 30 to March 5th 2017-18 and November 30 March 5th 2018-2019). Khagrachari situated in Agro-Ecological Zone (AEZ 23). The neighborhood District weather observation facility was habituated collect all meteorological information for the hilly area. The information covers rainfall and weekly means maximum and lowest temperatures. In Bangladesh's less significant wheat-producing regions of Khagrachari, research was directed over a two-year period. The seeds are going to be buried the last week of November. The way the plot is managed and its shape are destined by local conditions. During the wheat development season, this variety experiences uphill temperature stress due to natural temperature stress (15-35^{0}c). The experimental field sits 520 meters above sea level, where it is cooler at night and winter lasts longer than in central Bangladesh. When growing wheat, from December to March, the temperature ranges from 15.0° to 34.0° C with a mean of 17.0° to 24.0°C. Fig. shows the weekly average of lowest and maximum temperatures, relative humidity, and rainfall for the 2017 - 2018 and 2018-19 wheat growing season. The humidity range for the experiment periods in 2017 - 18 was 60 - 85% and it was the same in 2018 - 19. In the Khagrachari Hills, we experienced significant rainfall in March and April both Years. Sun shine hour was not noted during the two times. The trend in the average temperature over the past two years has been rather steady. The coldest month for the 2017 and 2018 crop seasons was January and middle February after which even a steady increase through to April. The typical temperature rose in March. For crop (wheat) growth and grain filling last year, the coolest months were December, January and February. The site had access to temperature forecast data for the years 2017, 2018, and March 2019 for both the highest and lowest temperatures. In compare to other wheat-growing regions around the nation, the mean maximum temperature in this location was 3 to 8 degrees Celsius higher.

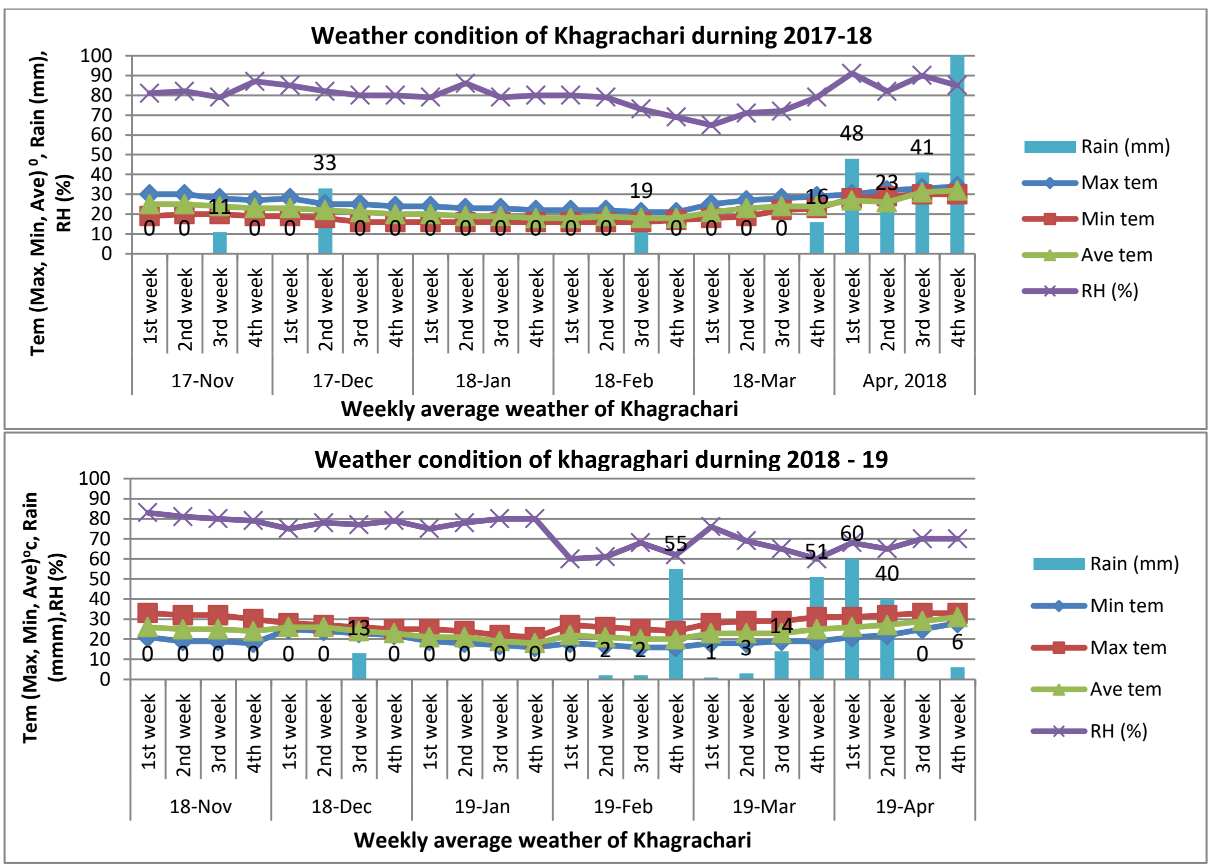

Fig. 1: Weather conditions throughout the 2017-18 and 2018-19 Khagrachari wheat growing seasons.

Experimental procedure

For testing the hill environment in the Khagrachari district, we used medium-high valley terrain. Wheat accessions with short maturing temperatures were tasted in one habitat in Khagrachari. Information about plots, sowing dates, harvest dates and localities is taken into account. Cow dung (5 tons/ha) and 230-150-100-110-20-10 Kg/ha of NPKSZB were used to fertilize the crop accordingly. During the land preparation process, cow dung was applied. At the final cultivation of the ground preparation, two-thirds of N and the remainder of other chemical fertilizer were applied. At 17 to 21 days after sowing or at the CRI (crown root initiations) stage after irrigation, one third of N was applied as top dressing. During the CRI, booting and grain-filling stages, the crop were irrigated three times to bring the soil moisture level nearly to field capacity. At 35 DAS (date after sowing), weeds were once physically eradicated by hand weeding. Crops were properly harvested when they reached maturity, sun-adhesive and cleaned on a sub-plot basis. The kernel output was then converted to t/ha^{-1} at a moisture level of 12 percent after the grains had been dried in the air. Ten plants from every plot were collected prior to harvest in order to manipulation. Following a conventional procedure, the initial plant populations were further numbered at 20 DAS. Collaborators sub-mitted information on the crop's plant population (PP), height (PH), heading days (HD), spike/m, grain/spike, spikelet/spike, days to maturity (MD), kernel output (t/ha) and biomass yields (BY). HD was considered as the count of days from the date of sowing/first irrigation until half of the spikes from the flag leaf had emerged. 50% of the spikes' peduncles had MD, which is a sign of senescence. Plots were maturely harvested on March 7th to determine GY. The average grade was checked using the least significant difference (LSD) at a threshold of 5% after statistical analysis of the entire datum. Utilizing statistic-10 software, all parameters were examined for evaluation. LSD was predicted to incorporate the variety's average grain yield.

Experimental Design

In order to conduct their experiment by the Rabi seasons of 2017 - 18 and 2018 - 19, researchers used an RCBD (randomized complete block design) with 3 duplications and six treatments. The main field maintains a 20 cm line-to-line and 1 inch plant-to-plant spacing. 5 ×4 meter main plot is used. All genotype lines provided stable grain yields under normal, gradual planting conditions with irrigation. Stress caused by exalted heats. In this experiment, five recently released wheat cultivars and one advance line with quick ripening times and tolerance to temperature changes were used.

Treatments	Varieties
T_1	BARI Gom 25 (Seed rate 120kg/ha)
T_2	BARI Gom 28 (Seed rate 120kg/ha)
T_3	BARI Gom 30 (Seed rate 120kg/ha)
T_4	BARI Gom 32 (Seed rate 120kg/ha)
T_5	BARI Gom 33 (Seed rate 120kg/ha)
T_6 (Advance line)	BAW 1147 (Seed rate 120kg/ha)

RESULTS AND DISCUSSION:

Plant populations

Trusting on the plant species, the environment might affect how a plant grows and improves. Air temperatures exceeding many species' optimal ranges are more likely to exceed optimal ranges in a scenario of accelerating climate change (Prasad *et al.,* 2001). Discovered the same thing (Prasad *et al.,* 2002). Because of the slow climate, few plants in the study field died after 10 to 14 days. No dead plants in the plots in this state have been found by BARI Gom 33. According to the study, there were 119 plants in the treatment group of Khagrachari T_5 BARI Gom 33 in 2018 - 19 and 118 in 2017 - 18 (**Table 3**). T_2 treatment In Khagrachari, BARI Gom 28 (98) and BARI Gom 25 (100) both had appallingly low levels. The lowest positions for Advanced Line 1147 (99) in 2017 - 18 and (105) in 2018 - 19 were found in just two years. BARI Gom 32 was in Khagrachari in (104) 2017 -18 and (107) 2018 - 19. There were no discernible differences in plant populations among the several hill locations. In order to compete with temperature impact, plants use a variety of methods. Avoidance, escape and tolerance are the top 3 (three) tactics used by plants to survive and flourish in hot settings. A plant's capacity to endure, thrive and produce a valuable harvest in a temperature-impacting environment is mentioned to as heat tolerance (Padam *et al.*, 2020).

Table 3: Yield and Yield Subscription Parameters of Khagrachari (Manik Sari) During 2017-18 and 2018-19.

Treatment	2017-18 Plant population	2018-19 Plant population	2017-18 Heading (days)	2018-19 Heading (days)	2017-18 Plant Height (cm)	2018-19 Plant Height (cm)	2017-18 Spike/m^2 (Amount)	2017-19 Spike/m^2 (Amount)	2017-18 Spikelet/ spike	2018-19 Spikelet/ spike
T_1 BARI Gom 25	101	100	51	52	91	90	190	183	9	9
T_2 BARI Gom 28	98	108	53	53	90	91	223	184	9	8
T_3 BARI Gom 30	111	118	57	56	94	95	208	222	13	13
T_4 BARI Gom 32	104	107	55	54	92	90	197	216	12	12
T_5 BARI Gom 33	118	119	58	57	96	96	220	214	14	16
T_6 BAW 1147	99	105	54	53	91	91	196	188	10	10
LSD (0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
CV (%)	2.40	2.92	0.27	0.75	0.46	0.84	11.72	4.88	0.32	4.44

Table 3: Continued.

Treatment	2017-18 Grains/ spike	2018-19 Grains/ spike	2017-18 Days to Maturity	2018-19 Days to Maturity	2017-18 1000 gw (g)	2017-18 1000gw (g)	2017-18 Grain Yield (t/h)	2018-19 Grain Yield (t/h)	2017-18 Biological Yield (t/h)	2018-19 Biological Yield (t/h)
T_1 BARI Gom 25	27	27	84	80	26	35	2.74	2.89	7.07	8.07
T_2 BARI Gom 28	26	24	86	83	24	37	2.59	3.10	6.70	8.03
T_3 BARI Gom 30	37	40	88	87	40	41	2.78	3.56	8.59	8.88
T_5 BARI Gom 32	35	38	87	86	36	39	3.00	3.40	7.96	8.33
T_5 BARI Gom 33	41	48	89	90	43	48	3.86	3.80	9.77	8.92
T_6 BAW 1147	31	29	86	86	30	38	2.96	3.04	7.60	8.14
LSD (0.05)	NS	NS	NS	NS	NS	NS	*	*	*	*
CV (%)	0.96	4.12	0.32	1.23	1.00	2.32	0.5	0.05	0.05	0.05

Days to heading

Regardless of location, BARI Gom 33 is a day or two later than the other varieties in the study. BARI Gom 30 has variations in regions after one day. They can take advantage of the hill's ability to adapt by doing so. BARI Gom 25 is 51 days in 2017 - 18 and 52 days in 2018 - 19 in 1 (one) hill region (districts), BARI Gom 28 is 53 days in both years, and BARI Gom 32 is 55 days in 2017 - 18 and 53 days in 2018 - 19. BAW 1147 was 54 in 2017 - 18 and 53 in 2018 - 19 (**Table 3**). Hilly environment-adapted cultivars had lengthy heading menses followed by brief periods and strong rates of kernel filling to reduce terminal extreme heat stress (25-35°C), as seen in the field. From February through April, highs of 22 to 35^0 °C are typically experienced in Bangladesh's highland districts. A developmental stage is the amount of days when the head, intellect or ear of the ear peep emerges from its surrounding sheath. The transition from some to full countenance is known as ear origin or heading (Acevedo *et al.* 2002). Tewolde *et al.* (2006) claim that earlier heading is effective under exalted heats stress because too many lush leaves are kept during anthesis, causing a smaller yield drop. According to (Spink *et al*., 1993) wheat's development took less time overall at exalted heats.

Plant height

Six wheat genotypes' plant heights under typical growing heat conditions are shown in Fig. The outcomes observed that the terminal heat effect of wheat accessions and growing conditions on plant height was not statistically significant in the variations. In both years of the experiment, BARI Gom 33 reached the largest height of a plant in the terminal heat growing environment (96 cm). BARI Gom 30 is the second tallest, standing at 94 cm in 2017 - 18 and 95 cm in 2018 - 19. BARI Gom 28 (90 cm) and BARI Gom 25 and 32 (90 cm) were the lowest plant heights in 2017 - 18 and 2018 - 19, respectively. BARI Gom 25 and BAW 1147 (91 cm) and BARI Gom 32 (92 cm), respectively, came in third and fourth place in 2017–18. Third position was BARI Gom 28 and BAW 1147 (91 cm) in 2018 - 19. All wheat genotypes experienced considerable shortening in plant height under continuous heat growing conditions, varying in magnitude. Due to phenotypic and combined influences of growing agreement, plant height changed in terminal heat. Heat stress may have slowed down plant outgrowth and the photosynthetic time in a sowing situation, conclusion in losses in plant height. The yields on plant height varied significantly amongst wheat genotypes (Mattas *et al.,* 2011 and Mohammad *et al.,* 2011). (Throne and Ford, 2001) Varied genotypes may result in different plant heights, and genotype genetic conditions may be involved.

Spike/m^2

It was disclosed that the genotype BARI Gom 33 performed better under mild heat stress. Also little better BARI Gom 30 as well as BARI Gom 33 in the study. Data in Fig. revealed that treatment T_5, T_2, BARI Gom 33, and BARI Gom 28 led to the maximum spikes (220) and (208) in the years 2017 - 18 and 214 and 184 in 2018 - 19, respectively. Treatment T_3 BARI Gom 30 (208) and BARI Gom 32(197) will come after that in 2017-18 years. The treatment T_1 BARI Gom 25 (190) 2017 - 2018 years and (183) 2018 - 2019 years showed the lowest rise. Fourth position BAW 1147(196) in 2017-18 (188) in 2018-19. The cultivar BARI Gom 25 failed to successfully protest the extreme high temperatures that were required for tillers, spikes, and robust growth. Treatment T_2 BARI Gom 28 (184) in 2018 - 19 and BAW 1147 (196) in 2017 - 18 years saw the fifth-highest rise. These variables have no statistically significant differences. Wheat crop yield is being decreased by a great amount of spikes. Because of this, BARI Gom 28 has the lowest kernel output in the 2017 - 18 experiment. The number of spikes per square meter is a crucial element in influencing grain production. Spike/m^2, the number of kernels is determined by the spike period which is determined by a person's genetic make-up. Environmental factors present at the time of the growth spike in grain production. The terminal kernel output is directly impacted by the wheat yield. Genetic differences across cultivars and varietals were most likely the cause of variations in the amount of spikes/m^2 (Islam, 1995). O'Toole and Stockle, (1991) state that when vegetative development and tillering advance towards the end of the GSI (Emergence to double in ridges) stage, susceptibility to heat rises. High temperature sensitivity shows up throughout this phase as a waning in the GS1 period along with a waning in leaf bound and growth (Shpiler and Blum, 1986). The overall amount of leaves and spike-bearing tillers is on the decline at this time of high temperatures (Midmore *et al.,* 1984). How many tillers would be stable under a heat stress condition in the posterior would entirely depend on their genetic makeup. The majority of genotypes do not consistently perform well in all circumstances; genetic effects are not entirely independent of environmental factors. The relative ranking of genotypes for yield when a genotype interacts with its environment typically changes when genotypes are analyzed over many atmosphere and years (Al-Otayk, 2010).

Spikelets/spike

One important component in determining grain output is the grain's total spikelet/spike content. The reach of the spike, its genetic composition, as well as environmental factors present at the moment of development, all influence the amount of spike-lets/spikes. Depending on the developing conditions, the amount of spikelets or spikes affects how much grain the wheat grower will ultimately produce. According to data in Fig., the therapy T_5 BARI Gom 33 resulted in the maximum spikelet (14) in the 2017 - 18 year and (16) in the 2018 - 19 year. The BARI Gom 30 treatment was followed by the treatments for (13) patients in 2017 - 18 and (13) patients in 2018 - 19. These two genotypes may benefit from longer heat waves and more favorable temperatures for accrual and improvement than other genotypes. These types' ability to develop may be slightly hampered by hot temperatures. Variations in spikelet/spike number within cultivars and varietals were most likely caused by genetic variations (Islam, 1995). Temperatures were high from emergence to the GSI (double ridges stage), which had an impact on the composition of florets and led to a smaller grain spike in crops that were sown recently.

As vegetative development and tillering get closer to the last of the GSI stage, vulnerability to extreme heat is said to rise (O'Toole and Stockle, 1991). High temperature sensitivity is seen during this phase as a shortening of leaf area and growth as well as a reduction in the periods of GS1 (Shpiler and Blum, 1986). According to (Owen, 1971) and (Saini and Aspinal, 1982) temperatures above 30°C during floret formation cause 100% sterility, which results in fewer grains spike. High wheat production might be forced by spikelet growth.

Grains/spike

The amount of kernels is a crucial component in spikes production. The numbers of grain depend on the shape of the spike, its genetic makeup, and any environmental factors present throughout the growth stage. Treatment T_5 BARI Gom 33 produced a greater quantity of grains spike-1, followed by Treatment T_3 BARI Gom 30 in two years (**Table 3**). Treatment BARI Gom 28, which was comparable to treatment BARI Gom 25 treated plot, produced the fewest grains spike-1. The third and fourth higher numbers of grains spikes-1 were discovered in BARI Gom 32 and BAW 1147 treated plots, which may be related to those plots' comparatively longer spikes and greater numbers of spikelets/-spike-1. The attendance of more nutrients as an outcome of nutritional variation may explain why there is noticeably more grains spike-1 in various treatments than in BARI Gom 33. Differences in grain size and spikes within cultivars and varietals were most likely caused by genetic variations (Islam, 2004)

1000-grain weight

In the current study, we discovered that treatment T_5 BARI Gom 33 produced the greatest 1000 kernel weight (43g) in the years 2017 - 18 and (48g) in 2018 - 19 respectively. The treatment's lowest 1000 kernel gravity was place to be Gom 28 (24g) in 2017 - 18 and BARI Gom 25 (35g) in 2018-19 (**Table 3**). It might initially work in BARI Gom 33's favor, but against BARI Gom 28. However, other kinds consumed less heat than BARI Gom 33, especially during the kernel filling stage. The head was incredibly high the last few times at the kernel filling stage, which finally reduced yield and shortened every improvement phage. BARI Gom 30 (40g, 41g) in the last two years had the second-highest yield per 1000 kernels pursued by the BARI Gom 32 (36g) in 2017-18 and (39g) in 2018-19 years. 4^{th} and 5^{th} 1000 kernels was (30g), (26g) in 2017-18 and (38g), (37g) in 2018-19 years. According to Sofied *et al.* (1977), elevated grain weight was produced when a favorable temperature was linked with a full corn filling length. Lower 1000 kernel weight was documented in hilly areas during BARI Gom 28 (24g) and (37g) two years due to elevated temperatures throughout the outgrowth stage, particularly after grain filling. This assertion is confirmed by the findings of Spink *et al*. (2000) and Shahzad *et al*. (2002) who also demonstrated losses in 1000 kernel weight with high temperature. Similar results have already been noted (Qamar *et al.*, 2004; Subhan *et al*, 2004).

Plants maturity

In wheat accession, high temperatures reduced physiological swelling and output contribution. Maximum period is required for physiological maturity to reach adulthood. When the typical leaf and spike turn yellow, that is when something is physiologically mature (Hanft and Wych, 1982). According to the study, treatment T_5 BARI Gom 33 had the foremost physiological ripeness of the cultivars, reaching that stage after 89 days in 2017 - 18 and 90 days in 2018 - 19 (**Table 3**). Treatment T_3 BARI Gom 30 came in second, reaching that stage after 88 days in 2017 - 18 and 87 days in 2018 - 19. Treatment for BARI Gom 32 took place in third place, lasting (86) days in 2018 - 2019 and (87) days in 2017 - 2018. The fourth condition was treated with T_6 BAW for 1147 (86) days and (86) days in the shower 2018 - 19. The last physiological maturity was treatment T_1 BARI Gom 25 (82) days and (84) days in double years of hill BARI Gom 28 was (86) days and (83) days in two years (**Table 3**) the duration of crop maturation is shortened by stress. Asana and Williams, (1965) found that mindless of accession for every 1^0C increase in heats during the grain-filling phase the daytime of grain-filling decreased by around 3-days. Owen, (1971) and (Saini & Aspinal, 1982) claim that temperatures exceeding 30°C during floret production result in 70% sterility, which losses the amount of kernel spike. The spikelet growth may be due to the high wheat yield. The days to physiological of wheat accession also indicated a wide periods of results because of the intrinsic variations between the cultivars (Shahzad *et al.,* 2007). According to Fischer, (1990), high temperatures reduce cultivars' life cycles from implantation to harvest and speed up their development.

Grain yield

Guilioni *et al.* (2003) set up that throughout the anthesis and grain-filling stages of many temperate cereal crops, heat stress alone or in conjunction with drought is a frequent constraint. For instance, the impacts of temperature stress on spring wheat kernels included a reduction in filling time and a slowing of growth, which led to losses of up to 7% in weight and density. The five types in our investigation were all strongly influenced by temperature, which judgmental in a notable loss in grain yield. On another way, genotypes varied in the rate of decline. According to Hasan (2002), every 1°C rise in the mean air heat from anthesis to ripeness compared to the typical growth conditions affects grain production by 2.6 to 5.8% in heat-tolerant cultivars and 7.2% in heat-sensitive cultivars.

The maximum kernel yield is produced by our hilly experiment with the cultivars BARI Gom 33 (3.86t/ha Khagrachari in 2017 - 18 and 3.80 t/ha in 2018 - 19) (**Table 3**). BARI Gom 30 had the second-best grain yield performance (3.56 t/ha and 3.78 t/ha in the 2017 - 18 and 2018 - 2019 seasons, respectively). BARI Gom 32 held the third spot (3.00 t/h in 2017 - 18 and 3.40 t/h in 2018-19 seasons). BAW 1147 (2.96 t/h), BARI Gom 25 (2.74 t/h), and BARI Gom 28 (2.59 t/h) had the fourth, fifth, and sixth highest yields in 2017 - 18, BARI Gom 25 (2.89 t/h), BARI Gom 28 (3.10 t/h), and BAW 1147 (3.04 t/h) in 2018-19. In the study's BARI Gom 25 (2.74 t/ha and 2.89 t/h Khagrachari) conducted in the 2017 - 18 and 2018 - 2019 seasons, the lowest kernel yield was determined. In a steep area, BARI Gom 33 performed best in yield and production both years (**Table 3**) BARI Gom 30, BARI Gom 32, and BARI Gom 28 come next. With the largest output and dry matter output of all six diversities, BARI Gom 33 was the best in terms of phonological stage variation in relation to growth and output, followed by BARI Gom 30 and BARI Gom 32. Accor-ding to Martiniello and Teixeira da Silva, (2011) changes in weather conditions (**Table 3**) in our experiment were revealed in crop phenology, growth, and improvement, eventually under ideal hillside conditions (Hossain *et al,*. 2011; Hakim *et al.,* 2012; Ali *et al*., 2022; Hossain *et al*., 2012a). The same kinds yielded in a separate order, according to Nahar *et al.* (2012b).

Biological yield

According to Toru and Wardlaw, (1988) temperatures exceeding 26.7°C shortened the grain growing season and dried up the atmosphere. Following to the figures, the output of straw varied significantly among cultivars in the hill. The cultivar with the best score in years 2017 - 2018 and 2018 - 2019 was BARI Gom 33

(8.92 t/ha and 9.77 t/ha Khagrachari). In years 2017 - 2018 and 2018 - 2019, pay attention to BARI Gom 30 (8.88 t/ha and 8.59 t/ha). BARI Gom 32 biomass yield was (7.96 t/ha and 8.33 t/ha) in the fiscal years 2017 - 18 and 2018 - 2019. The BARI Gom 28 plant produced the least biomass in the 2017 - 18 and 2018 - 2019 growing seasons (6.70 t/ha and 8.03 t/ha, respecttively). Fifth and sixth biomass were (8.14 t/h and 8.04 t/h), (7.60 t/h and 7.07 t/h) in years 2017 - 2018 and 2018 - 2019 respectively. A exalted heats that is unfavorable for physiological growth In periods of yield, BARI Gom 28 had the insignificant yield on the best sowing, accorded by BARI Gom 25 and BAW 1147. The intense heat during the vegetative periods might be to blame (**Table 3**). According to Kumer *et al*. (1994), the termination of a hostile environment (high heat) during the vegetative cycle led to crops growing thinly and producing fewer tillers, which decreased straw yield. BARI Gom 33 produces the maximum biomass due to his resistance to heat. According to Donaldson *et al*. (2001) heat-tolerant optimal planting led to a better straw outcome because of the enhanced amount of tillers. These results support those of Matuz and Aziz, (1991).

Economic Analysis

It was done a simple economic analysis. They were mentioned to as fixed expenses since the prices for labor, irrigation, fertilizer, seed, and land preparation were same throughout all applications. The expenses of urea, triple super phosphate, murate of potash, gypsum, born, and zinc sulfate were all regarded as variable costs. The farm gate prices of the output were profit from farmers and local markets for the purposes of calculating gross return, net return, and benefit cost ratio (BCR). The remainder received the same treatment from each management. Total cost was counted as the product of fixed and variable costs (Total cost = Fixed cost + Variable cost). The gross return was calculated using the major product's farm gate selling price. By dividing the gross return, the total price and the gross margin, the BCR was computed. 52,000 taka/ha is the entire cost of production, according to the economic study (all treatment are same). The treatments with the maximum gross returns are T_5=76,600 taka and T_3=64400 taka, respectively (**Table 4**). Third, fourth, and fifth brave comebacks following therapy T_3, T_6, and T_2.The smallest bold recovery following treatment T_1 is 56,200 Taka. Gross return x total production cost is the BCR (benefit cost ratio) calculation. (Treatment = T_5) has a BCR of 1.48. T_3 therapy comes after (1.24). Therapy = T_1 has the lowest BCR (1.08). We may conclude that BARI Gom 33 is superior to other options in the Khagrachari area because of this.

Table 4: By the Rabi season in 2017 - 18 and 2018 - 19, Khagrachari hills temperature on wheat variety develop and wheat types performed economically (average).

Treatment	Gross return	Total cost of production (TK/ha)	Gross margin (TK/ha)	Benefit cost ratio (BCR)
T_1	56,200/-	52,000/-	4,200/-	1.08
T_2	57,200/-	52,000/-	5,000/-	1.10
T_3	64,400/-	52,000/-	11,400/-	1.24
T_4	64,000/-	52,000/-	12,000/-	1.23
T_5	76,600/-	52,000/-	24,600/-	1.48
T_6	60,000/-	52,000/-	8,000/-	1.15

Local market wheat price 20/kg (taka), T_1=BARI Gom 25, T_2= BARI Gom 28, T_3= BARI Gom 30, T_4= BARI Gom 32, T_5= BARI Gom 33, T_6= BAW 1147.

CONCLUSION:

The conclusion is that the environment in hills has an important dominance on crop yield and its components. For the analyzed features of yield, the results showed that the BARI Gom 33 and BARI Gom 30 varieties significantly outperformed followed by the BARI Gom 32, BAW 1147, BARI Gom 28 and BARI Gom 25 accordingly. Wheat needs heat resistant genes to obtain higher yield and maturity. BARI Gom 33 and BARI Gom 30 are the best option for Khagrachari to get higher production.

ACKNOWLEDGEMENT:

The authors are grateful to the authority of the Regional Station (RS), BWMRI, Joydebpur, Gazipur, Bangladesh. The Chief Scientific Officer of RS provides financial support and cooperation.

CONFLICTS OF INTEREST:

The authors state that they don't appear to have any friction of part related to the study.

REFERENCES:

1) Acevedo, E., Silva, P., and Silva, H. (2002). Bread wheat, improvement and production, Wheat growth and physiology. https://www.fao.org/3/y4011e/y4011e06.htm
2) Akter, N., Islam, M. R. (2017). Heat stress effects and management in wheat. A review, *Agron. Sustain. Dev.* **37**, 37
3) Ali *et al*. (2022). Performance of new wheat yield in Bangladesh's three hill districts (Bandarban, Rangamati, Khagrachari). *Am. J. Pure Appl. Sci*., 4(4), 65-77. https://doi.org/10.34104/ajpab.022.065077
4) Al-Otayk, S. M. (2010). Performance of yield and stability of wheat genotypes under high stress Environments of the central region of Saudi Arabia. JKAU: Met. *Env Arid Land Agric. Sci*, **21**(1), 81-92. https://doi.org/10.4197/Met. 21-1.6
5) Altenbach, S. B. (2012). New insights into the effects of high temperature, drought and post-anthesis fertilizer on wheat grain development. *J Cereal Sci,* **56**, 39 - 50. https://doi.org/10.1016/j.jcs.2011.12.012
6) Asana RD, Williams RF. (1965). The effect of temperature stress on grain development in wheat. *Australian J. of Agricultural Research,* **16**, 1-3. https://www.publish.csiro.au/cp/AR9650001
7) Castro, M., Peterson, C. J., Ross, A. (2007). Influence of Heat Stress on Wheat Grain Characteristics and Protein Molecular Weight Distribution in Wheat Production in Stressed Environments, *Springer, Dordrecht. The Netherlands*, pp. 365 - 371.
8) Corbellini, M., Lafiandra, D., Borghi, B. (1998). Effect of heat shock during grain filling on protein composition and technological quality of wheats. *Euphytic,* **100**, 147-154. https://doi.org/10.1023/A:1018353300618
9) Donaldson, E., Schillinger, W.F. and Dofing, S. M. (2001). Straw production and grain yield relationship in winter wheat. *Crop Sci,* **41**, 100-106. https://doi.org/10.2135/cropsci2001.411100x
10) FAO FAOSTAT. (2019). http://www.fao.org/faostat/en/#data/QC
11) Farooq, M. *et al*. (2011). Heat Stress in Wheat during Reproductive and Grain-Filling Phases. *CRC Crit. Rev. Pl Sci*, **30**, 491-507 https://doi.org/10.1080/07352689.2011.615687
12) Fischer, A. S. (1990). Physiological limitation to producing wheat in semi-tropical and tropical environment and possible selection criteria. Wheats for More Tropical Environments. *Proc Int. Symp, Sept. 24-28,* CIMMYT, Mexico.
13) Ford, M. A. and G. N. (2001). Effect of variation in temperature and light intensity at different times on growth and yield of spring wheat. *Annals Applied of Biology,* **88**, 182-219. https://doi.org/10.1111/j.1744-7348.1975.tb01634 .x
14) Gibson, L. R., Paulsen, G. M. (1999). Yield Components of Wheat Grown under High Temperature Stress. *Crop Sci,* **39**, 1841-1846. https://doi.org/10.2135/cropsci1999.3961841x
15) Hanft JM, Wych RD. (1982). Visual indicators of physiological maturity of hard red spring wheat. *Crop Science.* **22**, 584-587. https://doi.org/10.2135/cropsci1982.0011183X0022%2000030036x
16) Hasan, M. A. (2002). Physiological changes in wheat under late planting heat stress. M.S thesis. Dept. Crop Botany. *Bongabandu Sheikh Mujibur Rahman Agril. Univ, Salna, Gazipur, Bangladesh.* https://doi.org/10.3329/baj.v21i1.39357
17) Hakim, M.A., Zvolinsky, VP. Khan, M. M. (2012). Yield, protein and starch content of 20 wheat (*Triticum aestivum L.*) genotypes exposed to high temperature under late sowing conditions. *J. of Scientific Research.* **4**(2), 477-489. https://doi.org/10.3329/jsr.v4i2.8679
18) Hossain, A., Zvolinsky, VP., Teixeira da Silva, JA. (2012). Effect of soil and climatic conditions on phenology of spring wheat varieties in the northern Bangladesh. Natural Sciences: *J. of Fundamental & Applied Sciences.* **39**(2), 78-86. https://www.researchgate.net/publication/283567287
19) Hossain, A., Sarker, M. A. Z., Zvolinsky, V. P. (2011). Effect of temperature on yield and some agronomic characters of spring wheat (*Triticum*

aestivum L.) genotypes. *InterJ. of Agricultural Research Innovation and Technology,* **1**, 44-54. https://www.banglajol.info/index.php/IJARIT/article/view/13932

20) Hurkman *et al*. (2003). Effect of temperature on expression of genes encoding enzymes for starch biosynthesis in developing wheat endosperm. *Pl Sci*, **164**, 873 - 881.
21) Islam, M. A. (1995). A study on the Competitive ability of six varieties of wheat with weeds. *Bangladesh Agricultural University. Department of Agronomy, MS Thesis*, pp. 30-33
22) Islam, M.A., Chandra, D., Barma, N. C. D. (2004). Variability and interrelationship of nine quantitative characters in F_5 bulks of five wheat crosses. *Pak. J. Biol. Scio*, **7**(6), 1040-1045. https://scialert.net/abstract/?doi=pjbs.2004.1040.1045
23) Kumer R, Madan S, Yunus M (1994). Effect of planting date on yield and quality of durum wheat varieties. *Research J. of Haryana Agricultural University,* **24** (4), 186-188 https://www.researchgate.net/publication/272483046
24) Liu, B., Asseng, S., Jones, J. W. (2016). Similar estimates of temperature impacts on global wheat yield by three independent methods. *Nat. Clim. Chang*, **6**, 1130 - 1136. https://doi.org/10.1038/nclimate3115
25) Mandal, R. P. Singh, E.R. Autrique, A.K. Joshi. (2016). Grain yield, adaption and progress in breeding for early-maturing and heat-tolerant wheat line in South Asia. *Field crops research j.*
26) Martiniello, P., Teixeira da Silva, JA, (2011). Physiological and bio–agronomical aspects involved in growth and yield components of cultivated forage species in Mediterranean environments: A review. *The European J. of Plant Science and Biotechnology,* **5**(2), 64-98. https://www.researchgate.net/publication/283514296
27) Mattas, K. K. Uppal, R. S. and Singh, R. P. (2011). Effect of varieties and nitrogen management on the growth, yield and nitrogen uptake of durum wheat. *Research J. of Agricultural Science*, **2**, 376-380.
28) Matuz, J. and Aziz, J.S. (1991). The effect of sowing season on Iraqi and Hungarian wheat varieties. Cereal Res. *Commun,* **18**, 41-43. https://www.jstor.org/stable/23783074
29) Midmore, D. J. Cartwright, P. M and Fischer, R. A. (1984). Wheat in tropical environments. II. Crop growth and grain yield. *Field Crops Research,* **8**, 207-227. https://doi.org/10.1016/0378-4290(84)90064-9
30) Mohammad, F. I. Ahmed, N. U. Khan, Shaheen and Ali, K. (2011). Comparative study of morphological traits in wheat and triticale. *Pakistan J. of Botany*, **43**, 1303-1310. http://www.pakbs.org/pjbot/PDFs/43(1)/PJB43(1)165.pdf
31) Nahar, K., Ahamed, KU., Fujita, M. (2010). Phenological variation and its relation with yield in several wheat (*Triticum aestivum L.)* cultivars under normal and late sown mediated heat stress condition. *Noulae Scientia Biologicae,* **2**(3), 51-56. https://doi.org/10.15835/nsb234723
32) O'Toole, J. C. and Stockle, C. D. (1991). The role of conceptual and simulation modelling in plants breeding. In E. Acevedo, E. Fereres, C. Gimenez and J.P. Srivastava, eds. Improvement and Management of winter Cereals under Temperature, Drought and Salinity Stresses. *National InstituteforAgriculturalResearch,Madrid, Spain*. https://doi.org/10.18801/ajcsp.050221.24
33) Owen P. C. (1971). Responses of semi-dwarf wheat to temperatures representing a tropical dry season. Extreme temperatures. *Expt Agr,* **7**, 43-47. https://doi.org/10.1017/S0014479700004774
34) Qamar, M., Ullah, S. and Makeen, S. (2004). Genetic variability among wheat cultivars and effect of planting date on grain and straw yield under double cropping zone of Northern areas of Pakistan. *Sarhad J. Agric*, **20**, 99-102 https://www.nature.com/articles/srep00066
35) Rahman, Ataur. M., and Alam, M. M (2015). Sowing time and varietal performance of wheat at higher elevation in hill environment at Khagrachari. *Bangladesh Agril Res*, **40**(4), 521-529. https://www.researchgate.net/publication/296689323
36) Rahman, M. A., Saifuzzaman, M., and Chikushi, J. (2002). Nitrogen management in rice-wheat alternating cropping system and wheat genotype identification preferable for surface seeding condition. *J. Fac Agr Kyushu Univ,* **46**(2), 295-300. https://doi.org/10.5109/24442

37) Rahman, M. A., Yahata, & E. Yasunsga. (2005). Effect of high air temperature on grain growth and yields of wheat genotypes differing in heat tolerance. *J. Agri Meteor,* **60**(5), 605-608.
38) Rahman, M. A., Sarker, M. M. R and Nazrul, M. I. (2013). Adaptability of wheat varieties in strongly acidic soils of Sylhet. *Bangladesh J. Agric. Res,* **38**(1), 97-104. https://www.banglajol.info/index.php/BJAR/article/view/15194
39) Saini, H. S. and Aspinal, D. (1982). Abnormal sporogenesis in wheat (*Triticum aestivum L.)* induced by short periods of high temperature. *Ann. Bot,* **49**, 835-846 https://doi.org/10.1093/oxfordjournals.aob.a086310
40) Semenov, M. A., Shewry, P. R. (2011). Modeling predicts that heat stress, not drought, will increase vulnerability of wheat in Europe. *Sci Rep,* **1**(66).
41) Shahzad, K., Bakht, J., Shafi, M. and Jabeen, N. (2002). Yield and yield compo-nents of various wheat cultivars as affected by different sowing dates. *Asian J. Plant Sci,* **1**(5), 522-525. https://scialert.net/fulltext/?doi=ajps.2002.522.525
42) Shahzad, M. A., Sahi, S.T., Khan, M. M. (2007). Effect of sowing dates and seed treatment on grain yield and quality of wheat. *Pakistan J. Agril. Sci,* **44**, 581-583 https://agris.fao.org/agris-search/search.do?recordID=PK2008001118
43) Shpiler, L. and Blum, A. (1986). Differential reaction of wheat cultivars to hot environments. *Euphytica*, **35**, 483-492. https://doi.org/10.1007/BF00021856
44) Sofied, I. L., Evans, T., Cook, M. G. and Wardlaw, I. F. (1977). Factor influencing the rate and duration of grain filling in wheat. *Australian J. Physiol.* **4**, 785-797. https://agris.fao.org/agris-search/search.do?recordID=AU7800319
45) Spink, J. H. Clare, R. W. and Kilpatricks, J. B. (1993). Grain quality of milling wheat at different sowing dates. *Appl Biol & Biotech*, **36**, 231-240. https://eurekamag.com/research/002/393/002393897.php
46) Spink, J.H. *et al.* (2000). Effect of Semere S sowing dates and planting density of winter wheat. *Ann. App. Biol,* **137**(2), 179-188. https://doi.org/10.1111/j.1744-7348.2000.tb000-49.x
47) Subhan, F., Khan, M., and Jamro, G. H. (2004). Effect of different planting date, seeding rate and weed control method on grain yield and yields components in wheat. *Sarhad J Agric*, **20**, 51-55. https://agris.fao.org/agris-search/search.do?reco-rdID
48) Tang, C., Diatloff, E. and Gazey, C. (2003). Response wheat and barley to liming on sandy soil with subsoil acidity. *Fiel Crop Res,* **80**, 235-244. https://doi.org/10.1016/S0378-4290(02)00192-2
49) Teixeira, E. I., Fischer, G., van. Ewert, F. (2013). Global hot-spots of heat stress on agricultural crops due to climate change. *Agric For Meteorol,* **170**, 206 - 215. https://doi.org/10.1016/j.agrformet.2011.09.002
50) Tewolde, C. J. H., Fernandez, C. A., Erickson. (2006). Wheat Cultivars Adapted to Post-Heading High Temperature Stress. *J. of Agronomy and Crop Science,* **192**(2), 111-120 https://agris.fao.org/agris-search/search.do?recordID
51) Timsina, J. and Cornor, D. J. (2001). Productivity and management of rice-wheat cropping systems: Issues and challenges. *Field Crops Res,* **69**, 93-132. https://doi.org/10.1016/S0378-4290(00)00143-X
52) Toru T, Wardlaw IF. (1989). A comparison of the effect of high temperature on grain development in wheat and rice. *Ann of Bot,* **64**, 59-65 https://agris.fao.org/agris-search/search.do?recordID=GB9010421

Citation: Ali MA, Alam MM, Hossain MT, Islam MR, Hossain MA, Huda MS, and Haque MN. (2022). Effect of hill temperature on wheat variety development and yield in the district of Khagrachari. *Am. J. Pure Appl. Sci.*, **4**(6), 103-114. https://doi.org/10.34104/ajpab.022.01030114