Performance of Exotic Wheat Genotypes under Agro-Climatic Conditions of Mansehra, Khyber Pakhtunkhwa

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Abstract: Yield performance studies encompasses twelve new advance lines against two local check varieties (Siran and Atta-Habib) of wheat (*Triticum aestivum* L.) having diverse origin was carried out at Agricultural Research Station Baffa, Mansehra, Khyber Pakhtunkhwa, Pakistan during 2012-13. The experiment was sown on November, 09, 2012. Macroscopic data recorded on grain yield, biological yield, plant height, number of tillers, 100 grain weight, spike length, spikelet's spike⁻¹, grains spike⁻¹, harvest index, flag leaf area (cm), peduncle length (cm), disease infection (rust and powdery mildew), days to germination and 50% heading were recorded during the course of study. Among genotype, advanced line 3011 produced maximum grain yield of 7875 kg ha⁻¹ against the check genotype Atta-Habib the lowest grain yielder with 5583 kg ha⁻¹. Genotype 3034 obtained maximum 100 grain weight (g) of 7.75, compared with check genotypes Siran and Atta-habib with 100 grain weight of 4.75 each. In case of grains spike⁻¹, the genotype Atta-Habib produced highest grains spike⁻¹ (75) while, genotypes 107 produced minimum grains spike⁻¹ (66). The genotypes 108, produced highest spike length (15) but minimum spike length of 12.5 was recorded for genotype 3008. Genotypes Atta-Habib, has maximum spikelet's spike⁻¹ (26.9), while minimum of 21.9 was acquired by genotype 115. The genotypes 3009 were the tallest with plant height of 98.9 cm whereas, minimum plant height 85 cm was recorded for genotype Siran. The genotypes 108, has highest number of tillers (10.9), while minimum tillers (6.9) by genotype 3025. Genotype 3035 has highest harvest index (43.2), but minimum of 29.3% was recorded for genotype Siran. Genotype 107 has highest straw yield (14917), while minimum (8667 kg ha⁻¹) was obtained by genotype 3089. Days to heading (50%) was in the range of 182-169 days among the tested genotypes.

Key words: Wheat genotypes, Khyber Pakhtunkhwa, Pakistan

INTRODUCTION

Wheat (*Triticum aestivum* L.) belong to the family Poaceae, is an annual self-pollinated rabbi crop. It is the most important grain and a staple food for more than one third of the world population. It is sown on 220 m ha around the globe with 564.6 Mt t production, an average of 2500 kg grain ha⁻¹ (Ul Abideen and Abideen, 2013). China sown wheat on around 30 m ha, followed by the Russian Federation; India, USA, Australia, Canada, Turkey and Pakistan. As far as the highest yield is concerned, France in Europe produces 7200 kg ha⁻¹ as it has much longer growing season of winter wheat. Among the wheat producing country, Pakistan stands at 10th position in terms of area (8.5 m ha) and 59th in terms of yield (21.0 Mt t) annually. Basheer-Salimia and Atawnah (2014), evaluated the morphological characteristics of six wheat genotypes, grown under rain-fed conditions at the southern highland of West-Bank, Palestine. The results showed significant differences among the six wheat

genotypes (stem length, tillering, grains spike⁻¹, spike length, spike length with awns, average spike weight, weight of 100 seeds genotypes⁻¹, maturation and harvesting date and total yield). Motavassel *et al.* (2013), evaluated the yield and related components of 20 wheat genotypes in the Agriculture and Natural Resources Research Centre of Ardabil (Moghan) in 2012-2013, showed significant differences among genotypes for all traits except number of grains spike⁻¹. Tahmasebi *et al.* (2013), evaluated agro-morphological characters during 2009-2010, on the Research Station located at Shirvan Chardavol, Ilam, showed significant difference in all character except grain filling period and number of grains spike⁻¹. Inamullah *et al.* (2011), studied nine wheat cultivars and an advance line, at Agricultural Research Station, Baffa (Mansehra) and Cereal Crop Research Institute, Pirsabak (Nowshera) during 2006-07. The two test locations differed significantly for days to heading, days to maturity, plant height, biological yield, grain yield and harvest index. Hussain *et al.* (2011), evaluated twenty

five wheat varieties for various morphological and yield related traits showed significant differences among the genotypes for flag leaf area, plant height, peduncle length, spike length, number of spikelet's spike⁻¹, number of grains spike⁻¹, yield plant⁻¹ and harvest index and non-significant for number of tillers plant⁻¹. Said *et al.* (2007) evaluated four varieties and sixteen lines of wheat at the Agricultural Research Farm of Khyber Pakhtunkhwa, Agricultural University and Peshawar during the year 2000-01. Genotype SP-85 and V1P6 gives maximum grain yield 750 kg ha⁻¹. Wahab *et al.* (2007) studied eight wheat (*Triticum aestivum* L.) varieties grown in Khyber Pakhtunkhwa, under identical conditions during the two consecutive crop years at Cereal Crop Research Institute, Pirsabaq, Now applying similar inputs and reported significant difference for parameter in both the crop years. Wang *et al.* (2001) suggested that photosynthesis in the exposed peduncle and flag leaf sheath contribute about 9-12% of grain dry mass, dependent on the wheat cultivar. Gebbing (2003) reported that "elongation of the exposed part of the peduncle lessens the risk of leaf-borne pathogen infections in the ear by increasing the distance between the upper leaves and the ear". Apart from abiotic factors, wheat is attacked by a number of diseases like rust that cause great losses to the quality and quantity of the produce (Hussain *et al.*, 2011; Bibi *et al.*, 2012). Thus,

development of high yielding and disease resistant wheat cultivars has at all times been a major objective of wheat breeding programs all over the world. Extensive testing of wheat genotypes under varying environments has been experienced for screening comparatively stable cultivars (Shafi *et al.*, 2013). There is a large opening between yield potential of our modern wheat varieties and yield production which sign posted that crop yield can be improved through better crop production (Laghari *et al.*, 2010). High yielding individual may be selected by focused upon the flag leaf area, number of tillers plant⁻¹, spike length, number of spikelet's spike⁻¹ and 1000 grain weight (Ashfaq *et al.*, 2003; Saleem *et al.*, 2006).

MATERIALS AND METHODS

A field experiment comprises of fourteen wheat genotypes including two check varieties i.e., 107, 108, 115, 117, 3008, 3009, 3011, 3015, 3025, 3034, 3035, 3089, Siran and Atta-Habib were conducted during 2012-2013 at Agricultural Research Station Baffa Mansehra (Fig. 1). The pedigree of these genotypes is shown in Table 1. The experiment was laid out in RCBD with 4 replications. Plot size of 4 rows having 5 m length with 30 cm row spacing was used. Experiment was sown on November 9, 2012. A basal dose of fertilizer was

Table 1: Pedigree and relevant information of wheat used in experiment during 2012-13

Genotype code	Pedigree/parentage
Siran	PBWC43*2/KUN CGSS99BOOO41F-099Y-099M-099Y-31Y-OB
107	PFAU/MILLAN/ 3/SKAUZ/KS94U21511 SKAU2 CMSS02 Y006155-47Y-OM-099Y-4M-OWGY-OB
108	KIRITATI/4/2/*SERI.1B*2/3/KAU2*21BOW11 KAUZ CGSS02 BOU120T-099B-099Y-099M-099Y-099M-20WGY-OB
115	PBW343*2/KAKUNA//PBW343*2/KAKUNA CGSS04Y 00099S-099Y-099M-099Y-099M-8WGY-OB
117	PBW343*2/KAKUNA//PBW343 KAKUNA CGSS04Y 00099S-099Y-099M-099Y-099M-22WGY-OB
3008	PROTNTA FEDERAL CM33203-M-8M-8Y-1-M-IY-1M-OY-1T-2T-OARG
3009	KLEIN CACIQUE OARG
3011	VOROBAY CMSS96YO2555S-040Y-020M-050SY-27M-OY
3015	NS-732/HER/3/PRL/SARA//TSI/VEE#5/4/FRET2 CMSA00Y00802T-O4OM-OPOY-040M-040SY-030M-1ZTM-0ZTY
3025	FILIN/2*PASTUR//PRL/2*PASTOR CMSA02Y06110S-040POY-040ZTM-040SY-040M-6ZTY-02M-OY
3034	SUNCO/2*PASTOR//EXCALIBUR CMSA02M00235S-32POY-OZTY-010M-010SY010M-3ZTY-03B
3035	CROC-1/AE.SUARROSA(205)//KAUZ/3/LANG CMSA04Y00142S-040ZTPOY-040ZTM-040SY-23ZTM-02Y-OB
3089	CHEN/AEGILOPS SUARROSE(TAUS)//BCN/3/BAV92 CMSA02Y00104S-040POY-040ZTM-040SY-040M/2ZTY-02M-OY
Atta-Habib	INQALAB 91*2/TUKURU CGSSGBOOO15F-099Y-099M-099Y-31Y-OB

Fig. 1: Map showing experimental site at District Mansehra, Khyber Pakhtunkhwa, Pakistan

applied at the rate of 120 N: 60 P₂O₅ kg ha⁻¹, in the form of Di-Ammonium Phosphate (DAP) and urea, with recommended seed rate of 100 kg ha⁻¹ was applied and incorporated at the time of seedbed preparation. All agronomic operations i.e., irrigation, weed eradication and plant protection measures were adopted as and when required equally for all plots to exploit full potential of the tested genotypes. Observations were recorded on days to emergence, 50% heading, plant height (cm), flag leaf area (cm), peduncle length (cm), disease infection (rust and powdery mildew), number of tillers, spike length (cm), number of grains spike⁻¹, number of spikelet's spike⁻¹, 100 grain weight (g), straw yield (g), grain yield (g) and harvest index (%). Plant height, number of tillers,

peduncle length and flag leaf area (cm) was recorded during developmental stage. Number of grains spike⁻¹, spikelet and spike length were determined by counting of five randomly selected plants from each treatments. Straw yield and grain yield was recorded from the two central rows of each sub-plot⁻¹ and then converted into kg ha⁻¹ and harvest index was determined from the ratio of grain yield to biomass.

The physiochemical analysis of experimental site was carried out during experiment. The experimental area falls in medium to high rain fed area of Mansehra. The soil of experimental sites were normally having pH range from 5.5-7.0, EC 0.52-0.91 dS m⁻¹ and texture class was sandy loam to silt loam.

Table 2: Meteorological Record at Baffa Mansehra at experimental during 2012-13

Months	Rainfall (mm) T	Temperature (°C)	
		Max.	Min.
October	234.0	31.5	11.4
November	32.0	26.2	6.9
December	59.4	21.3	5.4
January	14.9	20.1	4.0
February	190.8	21.5	6.2
March	113.0	28.2	11.0
April	112.0	30.0	13.5
May	53.0	34.2	16.3

T: Total, Max: Maximum, Min: Minimum

Meteorological data: The meteorological data for the entire growing period of the experimental crop were recorded from the Agro-Met Weather Station Agricultural Research Station Baffa, Mansehra, Khyber Pakhtunkhwa, Pakistan (Table 2).

Statistical analysis: Data was statistically analyzed using MSTATC, a computer software package (Bricker, 1991) and means were further separated through Least Significant Differences (LSD) test (Steel and Torrie, 1980).

RESULTS AND DISCUSSION

The data regarding days to germination is depicted in Table 4. Non-significant differences were observed in different genotypes including check varieties regarding number of days after sowing to germination at 5% probability level (Table 3). The minimum days to germination 7 days taken by genotype 3025, followed by genotype Atta-Habib and 3009 which took each 7.25 days, respectively. The genotypes 3015 and 3035 were the latest and took more days to germination from sowing i.e., 8. Difference in days to germination of the genotypes may be ascribed to the genetic characteristic of the genotypes as reported by Kakar *et al.* (2003). Anderson (2010) reported that environmental factors like temperature, solar radiation and rainfall show essential role in influential the performance of a crop cultivar. Similar conclusion was also published by Munsif *et al.* (2013), who also reported non-significant differences in different wheat genotypes. Highly significant differences were observed in different genotypes including check varieties at 5% probability (Table 3). The data regarding 50% heading is depicted in Table 4, revealed that minimum days to 50% heading of 134.25 days was noted for genotype Atta-Habib followed by genotypes Siran and 115, took 134.50 and 135.00 days, respectively. The genotypes 3035 and 3011 were the latest and took more days to 50% heading i.e., 142.75 and 140.75, respectively.

As, Mansehra geographically lying at a higher altitude and a little towards North in latitude, cooler environments have been narrated to delay flowering and maturity by Gardner *et al.* (1985), Taiz and Zeiger (2002). Inamullah *et al.* (2011) and Hassan *et al.* (2004) in an experiment on different wheat genotypes reported highly significant differences in different wheat genotypes.

Significantly minimum plant height of 85 cm was recorded for genotype Siran followed by genotype 3034 and Atta-Habib, 86.9 and 88.7 cm, respectively. The genotypes 3009, 3008 were the tallest among the tested genotypes with plant height of 98.9 and 98.8 cm (Table 4). Taller plant of wheat at Mansehra might have occurred because of the cooler climate, high moisture availability and longer maturity periods. Anderson (2010) reported that environmental factors like temperature, solar radiation and rainfall play pivotal role in determining the performance of a crop cultivar. Similar results were found by Nawaz *et al.* (2013), Inamullah *et al.* (2011) and Said *et al.* (2007), who reported significant differences in different wheat genotypes. Non-significantly minimum number of tillers (6.9) was noted for genotype 3025 followed by genotype 3015 and 3008 which were 6.9 and 7.4, respectively. The genotypes 108, 3035 were acquired highest number of tillers (i.e., 10.9, 10.7) (Table 4). This might be due to the proper utilization of applied plant nutrient, sunlight and genetic potentiality of the genotypes. The present findings are in agreement with results of Nawaz *et al.* (2013) and Ghasemi *et al.* (2010), which rectify the non-significant differences in different wheat genotypes. Significant differences were observed in different genotypes for spike length at 5% probability (Table 4). Minimum spike length of 12.5 cm was noted for genotype 3008 followed by genotype 3011 and 3009 with spike length 12.6 and 12.7 cm, respectively. While, maximum spike length of 15 cm was recorded each for genotypes 108 and 3015. Richards *et al.* (2001) reported that in cooler climates where sufficient moisture is available in the form of precipitation or irrigation during the wheat growing season, the crop thrives well and produce higher yield. Difference in spike lengths of the genotypes may be ascribed to the genetic characteristic of the genotypes as reported by Kakar *et al.* (2003) and Nawaz *et al.* (2013). Highly significant differences were observed in different genotypes for spikelet's spike⁻¹ at 5% probability (Table 4). Minimum spikelet's spike⁻¹ of 21.9 produced by genotype 115 closely followed by genotype 3009 and 3089 which were 22.9 and 22.9 spikelet's spike⁻¹, respectively. The genotypes Atta-Habib and 3011 produced with respective maximum spikelet's spike⁻¹ of 26.9, 26.2 (Table 4). Wheat cultivars show better vegetative growth and higher yields in comparatively cooler climates as compared with warmer

Mean sun of square

NS Non-significant, *Significant, **Highly significant, CV: Coefficient of variation

grain weight, straw yield, Biological yield, harvest index, grain yield

50%	Plant	Tiller	Flag leaf area (cm ²)	Peduncle length (cm)	Rust (0-10)	Powdery mildew (0-10)	Spike length (cm)	Spikelet spike ⁻¹	Grain weight (g)	100 grain straw yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)	Harvest index (%)	Grain yield (kg ha ⁻¹)
7.50 ^{a,c}	85.0e	9.9 ^{-d}	28.97 ^c	8.87 ^{cd}	1.25 ^{-d}	0.00 ^c	12.93 ^{ef}	24.90 ^{-c}	74.10 ^{ab}	4.75 ^c	1365.8 ^{ab}	29.37 ^g	5716.6 ^{ef}
7.75 ^{ab}	92.7 ^{ab}	9.5 ^{bc}	38.18 ^{ab}	8.20 ^{de}	0.00 ^d	2.25 ^{ab}	12.7 ^{-f}	24.02 ^{-g}	66.12 ^a	6.50 ^b	1491.7 ^a	30.87 ^{fg}	6708.3 ^{c,e}
7.75 ^{ab}	137.50 ^{-c,e}	10.9 ^a	38.26 ^{ab}	14.97 ^a	0.00 ^d	3.75 ^a	15.0 ^a	23.60 ^{-b}	70.78 ^{-d}	7.50 ^a	11500 ^{-c}	36.62 ^{-c,e}	6625.0 ^{-e}
7.75 ^{ab}	138.73 ^{cd}	9.7 ^{bc}	34.74 ^{bc}	9.90 ^{bc}	1.25 ^{-d}	2.75 ^{ab}	13.5 ^{bc}	21.97 ^{-f}	70.57 ^{-d}	7.50 ^a	17083 ^{-f}	39.87 ^{bc}	6708.3 ^{-c,e}
7.75 ^{ab}	135.00 ^{cd}	7.7 ^{bc}	34.74 ^{bc}	7.7 ^{bc}	1.25 ^{-d}	2.75 ^{ab}	13.5 ^{bc}	21.97 ^{-f}	70.57 ^{-d}	7.50 ^a	10375 ^{-c,f}	39.87 ^{bc}	6708.3 ^{-c,e}
7.75 ^{ab}	138.00 ^{bd}	8.9 ^{bc}	36.78 ^b	7.24 ^c	1.75 ^{ab}	3.25 ^{ab}	13.9 ^{bd}	23.95 ^{-g}	70.05 ^{-d}	6.50 ^b	12333 ^{bc}	33.25 ^g	6208.3 ^{-c,e}
7.50 ^{a,c}	98.8 ^a	7.4 ^c	40.96 ^a	10.91 ^b	0.00 ^d	2.00 ^c	12.5 ^f	24.40 ^{-f}	75.05 ^a	6.50 ^b	9833 ^{3,4f}	40.75 ^{ac}	6833.3 ^{3d}
7.25 ^{bc}	98.9 ^a	10.3 ^{-c}	37.39 ^{ab}	9.18 ^{cd}	0.75 ^{-d}	2.50 ^{ab}	12.7 ^{-f}	22.37 ^{hi}	68.27 ^{bc}	6.50 ^b	11792 ^{ab}	37.75 ^{ac}	7166.6 ^{4bc}
7.75 ^{ab}	98.3 ^a	9.5 ^{bc}	30.01 ^{de}	10.87 ^{ab}	0.25 ^{-cd}	3.25 ^{ab}	12.6 ^{-f}	26.25 ^{ab}	68.45 ^{-c}	7.50 ^a	13375 ^{5b}	37.00 ^{-c}	7875.0 ^{-f}
8.00 ^a	140.50 ^{ab}	6.9 ^{-c}	33.02 ^{cd}	8.23 ^{-c}	1.75 ^{ab}	2.50 ^{ab}	15.0 ^a	24.92 ^{-e}	72.10 ^{-c}	7.00 ^{ab}	17083 ^{-c,f}	38.50 ^{ab}	6583.3 ^{-c,e}
7.00c	138.25 ^{bd}	6.9 ^{-c}	27.97 ^e	9.86 ^{bc}	2.00 ^a	1.50 ^{-c}	14.0 ^{bc}	23.47 ^{-h}	71.80 ^{-c}	7.50 ^a	10298 ^{-f}	42.50 ^{ab}	7625.0 ^{ab}
7.75 ^{ab}	139.73 ^{de}	10.2 ^{-c}	35.29 ^{bc}	7.15 ^c	0.00 ^d	1.00 ^{-c}	13.9 ^{-d}	25.00 ^{-d}	70.77 ^{-b}	7.75 ^a	9083 ³	15625 ^{fg}	6541.6 ^{-e}
8.00 ^a	142.75 ^{ga}	10.7 ^{ab}	32.69 ^{cd}	7.21 ^f	1.50 ^{-c}	2.25 ^{ab}	13.2 ^{-f}	35.65 ^{-c}	70.42 ^{-c}	7.50 ^a	9208 ^{4f}	43.25 ^a	7041.6 ^{4bc}
7.50 ^{a,c}	136.25 ^{df}	9.5 ^{bc}	35.87 ^{bc}	7.25 ^c	0.00 ^d	2.75 ^{ab}	14.5 ^{ab}	22.95 ^{gi}	72.42 ^{-c}	5.50 ^c	8667 ¹	35.12 ^{def}	6125.0 ^{4f}
7.25 ^{bc}	88.1 ^{bc}	9.3 ^{-c}	30.42 ^{de}	8.85 ^{-c,e}	1.25 ^{bc}	1.25 ^{bc}	13.3 ^{-d,f}	26.92 ^a	75.52 ^a	4.75 ^c	8833 ³	37.75 ^{bc}	5583.3 ^{4f}

climates. In Mansehra, because of its cooler climate, the grain formation and filling period of the yield contributing traits like the spikelet's spike⁻¹ was longer. Such highly significant variation in spikelet's spike⁻¹ have also been reported by different researchers (Hassan *et al.*, 2004; Akhtar *et al.*, 2001). Significant differences were observed in different genotypes for rust disease infection at 5% probability (Table 4). Genotypes 3089, 3034 and 3008 were resistant as there were no attack of diseases, against the susceptible genotypes 3025 and 117, score as 2 and 1.7, respectively (Table 4). Such difference in rust disease infection in the genotypes may be ascribed to the genetic characteristic of the genotypes as reported by Kakar *et al.* (2003), Nawaz *et al.* (2013) and Hassan *et al.* (2004).

In case of powdery mildew disease infection non-Significant differences were observed in different genotypes (Table 4). Variety Siran was found resistant, however genotype 3034 and Atta-Habib were moderately resistant in the test. Genotypes 108 and 117 were among the most susceptible lines for powdery mildew disease attack ranked as 3.7, 3.2. Difference in disease infection (rust) in the genotypes may be attributed to the genetic makeup of the genotypes as reported by Kakar *et al.* (2003). The genotypes Atta-Habib and 3011 produced significantly highest flag leaf area of 26.9 and 26.2 cm against the minimum flag leaf area of 21.9 noted for genotype 115 followed by genotypes 3009 and 3089 with flag leaf area of 22.9 and 22.9 cm, respectively. The result are an agreement with the findings of Nawaz *et al.* (2013). The genotypes 108 and 3008 obtained the highest peduncle length of 14.9 and 10.9 cm against minimum peduncle length of 2.17 noted for genotype 3035 followed by genotype 3034 and 117 which were 7 and 7 peduncle length. Elongation of the exposed part of the peduncle lessens the risk of leaf-borne pathogen infections in the ear by increasing the distance between the upper leaves and the ear (Gebbing, 2003). Similar results found by Nawaz *et al.* (2013), who also reported highly significant differences in different wheat genotypes.

Highly significant differences were observed in different genotypes for number of grain spike⁻¹ at 5% probability (Table 4). Minimum number of grain spike⁻¹ of 66 was produced by genotype 3035 followed by genotype 3034 and 117 which were 68, 68 number of grain spike⁻¹. However, genotypes 3008 and Atta-Habib produced highest number of grain spike⁻¹ of each 75 (Table 4). Khan *et al.* (2012), supported increase in grains spike⁻¹ at Mansehra may be due to the cooler environment and longer growing period, which favored grain setting. Richards *et al.* (2001) reported that in cooler climates where sufficient inputs are available in growing season, the crop produce higher yield. Similar results

highly significant were published by Nawaz *et al.* (2013), Hassan *et al.* (2004), Akhtar *et al.* (2001) and Musaddique *et al.* (2000).

Significantly highest grain yield of 7875 kg ha⁻¹ was produced by genotype 3011 closely followed by genotype 3025 with 7625 kg ha⁻¹, against the commercial check varieties Atta-Habib and Siran with respective yield of 5583 and 5716 kg ha⁻¹ (Table 4). Rane *et al.* (2007) reported that favorable weather variables especially the temperature and moisture availability in the form of irrigation or precipitation during the grain filling period of wheat actually determine the final grain yield of the crop. The result on grain yield (kg ha⁻¹) highly significant differences agrees with Inamullah *et al.* (2011), Hassan *et al.* (2004), Akhtar *et al.* (2001) and Musaddique *et al.* (2000). Significantly highest 100 grain weight (g) of 7.7 was recorded by genotypes 3034, closely followed by genotype 108 with 100 grain weight of 7.5 g (Table 4). While minimum 100 grain weight (g) of 4.7 was acquired by genotype Siran followed by genotype Atta-Habib and 3008 which each of 5 g (Table 4). Mollasadeghi *et al.* (2012) reported that irrigation during grain filling increases grain weight through increasing photosynthetic materials and remobilizing them into the grain. In Mansehra, because of its cooler climate, the grain formation and filling period of gains was longer which resulted in higher 100 grain weight (g). The present finding are in agreement with Nawaz *et al.* (2013) and also support by Hassan *et al.* (2004) and Akhtar *et al.* (2001).

Significantly maximum straw yield of 14917 and 13658 kg ha⁻¹ were produced by genotypes 107, Siran, against the minimum straw yield of 8667 kg ha⁻¹ noted for genotype 3089 followed by genotype Atta-Habib and 3034 with respective straw yield of 8833, 9083 kg ha⁻¹. In Mansehra, cultivars grew more energetically and most of them noted higher plant heights and tillers due to which their straw yield increased. The results about straw yield (kg ha⁻¹) coincide with the findings of Akhtar *et al.* (2001).

The highest biological yield of 21625 and 21250 kg ha⁻¹ were produced by genotypes 107 and 3011 (Table 3) whereas, minimum biological yield (kg ha⁻¹) of 14417 was recorded for genotype Atta-Habib closely followed by genotype 3034 and 3035 with 15625, 16250 kg ha⁻¹. Cultivars having more plant height mostly noted more biological yield, however, grain yield seems to have a vital role in determining the biological yield. The result about biological yield (kg ha⁻¹) rectify with Inamullah *et al.* (2011), who also reported highly significant differences. The genotypes 3035 and 3025 were possessed highest harvest index i.e., 43.2, 42.5, against the minimum harvest index of 29.3 obtained by

genotype Siran followed by genotype 107 and 117 which were 30.8, 33.2% (Table 4). In Mansehra, grain yield was extra ordinarily higher which consequence in higher harvest index. Donmez *et al.* (2001) reported that the harvest index in wheat is mostly allied related with increases in grain yield. Nawaz *et al.* (2013), Inamullah *et al.* (2011) and Musaddique *et al.* (2000) have shown similar results (highly significant) in harvest index (%) in different wheat genotypes.

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