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Evaluation of some agro-morphological traits diversity in Iranian bread wheat genotypes

Ocena wybranych agro-morfologicznych cech irańskich genotypów pszenicy zwyczajnej

ABSTRACT

Variation of traits is a primary need of any plant breeding effort that involves the natural evolution and causes sustainable crop production under different environments. Fifty six bread wheat genotypes grown during the growing season of 2012/2013 were evaluated for variability characteristics for eighteen traits i.e., stem diameter, plant height, leaf number, leaf length, leaf width, tiller number, internode length, peduncle length, spike length, floret number, spikelet number, grain number, awn length, grain diameter, grain length, number of days to flowering, thousand seed weight and grain yield. Significant differences were observed for all the traits studied, indicating a considerable amount of variation among wheat genotypes for each trait. The estimates of the coefficient of variation (CV) were high for grain yield and number of tillers per plant. Spike length varied from 8.95 in G28 to 4.74 in G40, while genotype G20 had the maximum floret number (19). According to thousand seed weight, genotype G55 had the maximum thousand seed weight (45.57 g) and genotype G4 had the maximum grain yield performance (6936.3 kg ha^{-1}). The information on diversity among the agro-morphological traits of the studied wheat genotypes will be helpful to plant breeders in constructing their breeding materials and implementing selection strategies.

Key words: bread wheat, grain yield, morphological traits, yield components

STRESZCZENIE

Podstawowym warunkiem branym pod uwagę w hodowli roślin jest zmienność cech, która jest związana z naturalną ewolucją i zapewnieniem zrównoważonej produkcji rolnej w zróżnicowanych środowiskach. U pięćdziesięciu sześciu genotypów pszenicy, uprawianych w Maragheh (Iran), w okresie wegetacyjnym 2012/2013 oceniono cechy zmienności biorąc pod uwagę osiemnaście cech metrycznych tj.: średnicę łodygi, wysokość rośliny, ilość liści, długość i szerokość liścia, liczbę pędów, długość międzywęźla, długość osadki, długość kłosa, liczba kwiatów, liczbę kłosków, liczbę ziarniaków, długość ości, średnicę ziarniaka, długość ziarniaka, liczbę dni do zakwitania, wagę tysiąca nasion i plon. Zaobserwowano znaczące różnice we wszystkich badanych cechach, co wskazuje na znaczną zmienność cech genotypów pszenicy. Wartości współczynnika zmienności (CV) były wysokie dla plonu ziarna i ilości pędów. Długość kłosa zmieniała się od 8,95 u G28 do 4,74 u G40, podczas gdy genotyp G20 miał maksymalną liczbę kwiatów (19). Największą wagę tysiąca nasion miał genotyp G55 (45,57 g), a genotyp G4 miał maksymalną wydajność plonu ziarna (6936.3 kg ha^{-1}). Dane na temat różnorodności wśród cech agro-morfologicznych badanych genotypów pszenicy będą pomocne w wyborze i zastosowaniu strategii selekcji materiału siewnego przez hodowców.

Słowa kluczowe: pszenica zwyczajna, plon, cechy morfologiczne, składniki plonu

INTRODUCTION

Bread wheat (*Triticum aestivum* L.) is one of the most important cereal crops and it has been related to the development of the some famous civilizations. Wheat is cultivated on about 228 million ha around the world, and Iran is cultivating about 8 million ha of wheat, of which about 5 million ha is under rain-fed conditions of arid and semi-arid areas and the remaining area is irrigated (Peymaninia et al. 2012). There is a requirement to increase wheat production worldwide, particularly in developing countries, and to increase the genetic potential of wheat, it is important to grasp the genetic basis of grain yield (Yang et al. 2006). The remarkable increase in wheat grain yield within the last decades has been achieved through plant breeders' efforts to produce new improved cultivars (Khamssi and Najaphy, 2012). Continuing these efforts to obtain high yielding cultivars, gives strength to increase the life expectancy of future population. Bread wheat was cultivated on an area of about 7.0 million hectares during 2011–2012 growing season with a production of 13.8 million tons (FAOSTAT, 2012).

Landraces and old cultivars of wheat have been grown from past years until now and they have a great adverse influence on production, quality, and security of human food (Parry et al. 2004; Atkinson et al. 2008). The local cultivars are not identified as high yield and high protein content, and their adaptability to modern agriculture requires to be addressed in wheat breeding programs. Genetic improvement of such local cultivars is a strategy used to improve grain yield and yield stability in different environmental conditions (Ortiz-Monasterio et al. 1997; Koutis et al. 2012). The grain yield characteristic in most arid and semi-arid areas is mainly decreased due to the narrow genetic base of the more recently new improved wheat cultivars (Annicchiarico and Pecetti, 1993). Selection of wheat genotypes appropriate for low-input agriculture needs a different strategy than that used for modern agriculture with high inputs. Thus, the use of adapted germplasm from its original diversity centre could be more useful for a successful wheat breeding program (Pecetti et al. 1994).

There is a requirement to identify proper genetic resources among the local cultivars and landraces of wheat, either for direct use or as parental lines in breeding programs. The local cultivars and landraces of wheat are adapted to the different conditions; therefore, they are valuable tools for identifying proper strategies for achieving high grain yield in arid and semi-arid areas (Lammerts-van-Bueren et al. 2005). Wheat production can be increased through production of high yielding genotypes for several environmental conditions, and selection for grain yield can be effective if sufficient genetic variation is present in the plant materials (Moragues et al. 2006). The grain yield is related to thousand seed weight and the number of spikes per unit area. Additionally, Dwivedi et al. (2002) found that the number of tillers per plant exerted a substantial effect on grain yield, while Kumar et al. (2003) reported high genetic advance for plant height, number of spikelets per spike, and thousand seed weight in wheat.

Development of new wheat cultivars that consistently give high grain yield under semi-arid regions would be advantageous to wheat farmers in Iran. The present investigation was conducted to get sufficient information on the grain yield and other wheat traits, under semi-arid condition in the present breeding plant material for effective selection of a future genetic improvement program of bread wheat. The major objective of the investigation was to evaluate wheat genotypes for grain yield and other morphological traits.

MATERIALS AND METHODS

The research was carried out in the experimental field of the University of Maragheh, Iran (37°23´N; 46°16´E). Tillage of all plots was performed prior to the sowing date, and fertility was constrained by low organic matter and phosphorus contents. There were six rows 2.5 m long and 0.25 m apart and the plot size was 3.75 m^2. Plots were overplanted and thinned to a distance between plants in the row of 10 cm for an established plant density of 16.7 plants m^{-2}. The fertilizer application was performed before sowing, 60 kg ha^{-1} of N, 30 kg ha^{-1} of P, and 20 kg ha^{-1} of K were broadcast on the surface and tilled into the soil, and the weeds were controlled chemically. The seed of 56 wheat cultivars and lines was sown in a randomized complete block design with three replications. Normal agronomic and cultural practices were applied to the experiment throughout the growing season according to local practices.

Some random plants (ten numbers) from each line were tagged randomly before harvesting to study different post emergence plant traits and data were recorded for stem diameter (SD), plant height (PH), leaf number at flowering (LN), flag leaf length (LL), flag leaf width (LW), tiller number (TN), internode length (NL), peduncle length (PL), spike length (SL), floret number per spikelet (FN), spikelet number (SN), grain number per spike (GN), awn length (AL), grain diameter (GD), and grain length (GL). The number of days to anthesis or flowering (DF), thousand seed weight (TS) and grain yield (GY) of each plot were measured. Analysis of variance (ANOVA) for all of the measured traits was performed with the conventional method using SAS statistical package. The least significant difference procedure (LSD) was used to carry out and compare mean differences.

RESULTS AND DISCUSSION

Analysis of variance showed a significant difference ($P<0.01$) for all of the measured traits in 56 wheat genotypes (Table 1). These findings could be a result of the large variation among wheat genotypes and reflect their genetic differences. Such a considerable range of phenotypic variations provided a good opportunity for improvement of wheat grain yield. The estimates of the coefficient of variation (CV) were high for grain yield (25.61%), and number of tillers per plant (22.06%) and number of grains per spike (21.45). Similar large CV amounts were reported for both of the mentioned wheat traits by Ali et al. (2008). The other remaining traits exhibited moderate to low CV estimates, i.e. from 14.30% in grain number per spike to 4.81% in days to flowering (Table 2). The development of different morphological traits in wheat is a highly coordinated process; therefore, for an effective breeding program, it is necessary to consider all of the important traits that have an impact on grain yield performance.

Mean values and their comparisons obtained using the LSD procedure for the measured traits of 56 wheat genotypes are presented in Table 3. According to the trait of days to flowering, genotypes G16 and G24 were the earliest genotypes, while G3 and G42 were the latest genotypes, and DF ranged from 80.67 to 89.33 with an average of 85.24. Stem diameter ranged from 2.07 to 4.50 with an average of 3.19 mm, and genotypes G26, G29, G33, and G49 were the thinnest genotypes, while G10 and G56 were the thickest genotypes (Table 3). The results of this investigation indicated that wheat plants from genotypes G20 and G22 were significantly higher (107.45 and 109.53 cm, respectively) than the other genotypes. The lowest plant height (54.90 cm) was reported from wheat genotype G14. Mahmoodet al. (2006) obtained different results for wheat plant height ranging from 62 cm to 110 cm, while Aliu and Fetahu (2010) reported a range from 71 to 79 cm for plant height in different bread wheat genotypes.

According to the leaf number trait (Table 3), genotype G31 had the maximum leaf number (7.33 leaves), while G30 had the minimum leaf number (4 leaves). Flag leaf length ranged from 8.82 to 22.22 cm and genotype G51 exhibited the longest leaf length while genotype G40 had the shortest leaf length. Nazem and Arzani (2013) found that the flag leaf length of some Iranian wheat genotypes varied from 11.4 to 15 cm, while our genotypes showed more variation. As for the flag leaf width (Table 3), genotype G6 had the longest leaf width (11.5 cm), while G53 had the shortest leaf width (4.47 cm). The tiller number ranged from 1 to 6, and genotype G4 had the maximum tiller number while genotype G11 had the minimum tiller number. In terms of the internode length (Table 3), genotypes G31 and G3 had the longest internode length (19.65 and 19.30 cm, respectively), while genotype G54 had the shortest internode length (11.23 cm). According to Austin and Jones (1975), most of the variations in the wheat plant height variations are attributable to differences in internode length rather than internode number.

As for the trait of the peduncle length character (Table 3), genotype G31 (36.26 cm) had the longest peduncle length while genotype G40 (21.45 cm) had the shortest peduncle length. According to Borner et al. (2002), peduncle length is very important in the disease escape mechanism; therefore, it could be used for genetic improvement of head disease resistance, since genotypes with a longer peduncle are more resistant to leaf rust and fusarium head blight. Spike length varied from 8.95 in G28 to 4.74 in G40 (Table 4); similarly, in investigations of 30 bread wheat genotypes, Fuma et al. (2005) found a high variation for all agronomic traits, especially spike length. Genotype G20 (19) had the maximum number of florets. There were large variations among the floret number of the studied wheat genotypes, because not all spikelet florets are fertile and the number of fertile florets depends on genetic and ecological factors (Sabo *et al.* 2002).

In terms of the spikelet number (Table 4), genotype G25 had the maximum spikelet number (54 spikelets), while G42 had the minimum spikelet number (26 spikelets). Grain yield is influenced by spike properties and the spikelet number plays a very important role in wheat grain yield. The grain number ranged from 3.67 (G25) to 2.00 (G30), and according to Subedi et al. (2000), when wheat is stressed during reproductive development, the grain number in fertile florets is reduced. The grain number is regarded as the main wheat yield component and an increased grain number has been produced by spikes per unit area or more grains per spike due to a higher spikelet number or higher floret fertility (Adhikary et al. 2009). As for the trait of the length of the awn (Table 4), genotype G12 (6.53 cm) had the longest awn, while genotype G19 (0.77 cm) had the shortest awn. Similarly, Moghadam et al. (1997) demonstrated that awn length varies in different wheat landraces.

Grain diameter ranged from 3.34 mm (G18) to 2.43 mm (G36), while grain length ranged from 7.45 mm (G4) to 5.59 mm (G36). One of the main components of the wheat yield is grain size, because it affects yield, and increasing grain size continues to be a major breeding target. In terms of thousand seed weight (Table 4), genotype G55 had the maximum thousand seed weight (45.57 g). Thousand seed weight is one of the important parameters in wheat that increases seed germination percent, seedling emergence, tillering, density, spike, and yield. Wheat grain yield integrates two main components, the grain number and thousand seed weight, which are determined at different times of the growing season (Borras et al. 2004; Peltonen-Sainio et al. 2007). Reynolds et al. (2002) suggested that thousand seed weight best explained genotype by environment interaction for wheat grain yield.

As for grain yield (Table 4), genotype G4 had the maximum grain yield performance (6936.3 kg ha^{-1}). The wheat grain yield is a function of the rate and duration of accumulation of dry matter in the seed fraction, and factors affecting either the rate or duration will have a large effect on grain yield performance (Adhikary et al. 2009). As high grain yield performance is the main target of wheat breeding programs, yield component traits have to be taken into consideration, especially when considering the needs of the wheat processing industry (Peltonen-Sainio *et al.* 2007).

Selection of superior wheat genotypes regarding high grain yield would be as effective as selection for its components, namely the number of spikes per plant, grain number per spike, and thousand seed weight (Peltonen-Sainioa et al. 2007). The relation of these traits with grain yield and the interrelationships have special importance as the basis for selecting high yielding genotypes. In this study, the morphological variation of different traits among 56 wheat genotypes were studied and indicated that there were large genetic variations. In a majority of previous investigation, similar results have been reported for morphological variations in bread wheat (Moghaddam et al. 1997; Golabadi et al. 2005).

In this study, we analysed the variability of bread wheat genotypes of Iran on the basis of the morphological traits, and the indirect estimation of genetic variation through morphological characterization showed high variability, which provides a good background for future studies of quantitative trait loci. This variability among genotypes is expressed in differences of earliness, plant height, grain properties, and spike characters, and they could be used to select favourable traits for crosses in the genetic improvement programs. A similar strategy has been developed in other regions of the world (Zarkti *et al.* 2012). Further research based on biochemical or molecular markers must be performed in future to grasp the genetic variations in these bread wheat genotypes. Analysis of the morphological characteristics in wheat genotypes revealed that a majority of the measured characteristics exhibited high variation. Grain yield had the maximum coefficient of variation, and number days to flowering had the minimum coefficient of variation. Nazem and Arzani (2013) reported similar results for the coefficient of variation in grain yield and number days to flowering in other Iranian wheat genotypes.

CONCLUSIONS

The genetic potential seems to exist relatively for developing new varieties possessing most variations of different traits, especially grain yield performance. With similar knowledge about wheat traits, one may find applications for wheat possessing grain yield other than those previously available. Thus, further breeding efforts may be required to clarify the relationships among different wheat traits.

Our results showed significant differences among morphological and yield components between wheat genotypes. The research suggests that the wheat genotypes represent a high genetic valuable variation for grain yield, spike length, and thousand seed weight, and these plant materials could be successively used in production in different environmental conditions, as they have a good perspective from various aspects.

Table 1. The name and code of 56 bread wheat genotypes.

Code	Name	Code	Name	Code	Name
G1	Niknezhad	G20	C-85-9	G39	Chanab
G2	Alvand-1	G21	Arvand	G40	Sorkhtokhm
G3	Shahpasand	G22	Hirmand	G41	C-84-5502
G4	Pishtaz	G23	Zagros	G42	Omid
G5	Marvdasht	G24	Shiroodi-1	G43	Akbari
G6	Golestan	G25	Zarin	G44	Tabasi
G7	MS-81-14	G26	Azar-2	G45	Shiraz
G8	C-85-11	G27	C-85-13	G46	Line A
G9	Sepahan	G28	Alvand-2	G47	Mahdavi-1
G10	C-84-55-B	G29	Verinak	G48	Mahdavi-2
G11	Chamran	G30	C-85-5512	G49	B-Roshan
G12	Norstar	G31	Roshan-2	G50	Shahriar
G13	Karaj-3	G32	Ghods	G51	Bahar
G14	Sabalan	G33	Cross shahi	G52	Kavir
G15	Arta	G34	Tous	G53	Shiroodi-2
G16	Alborz	G35	Moghan-1	G54	Falaat-2
G17	Bayat	G36	CDC-Ospray	G55	Sistan
G18	C-85-8	G37	Falat-1	G56	Saison
G19	Roshan-1	G38	Tajan		

Table 2. Analysis of variance for 18 measured traits in 56 wheat genotypes

S.O.V.	d.f.	Mean Squares					
		DF (day)	SD (mm)	PH (cm)	LN (No.)	LL (cm)	LW (cm)
Replication	2	9.22*	0.036ns	19.59ns	0.310ns	3.19ns	0.026ns
Genotype	55	14.84**	0.623**	449.84**	1.514**	22.74**	6.459**
Error	110	0.17	0.059	18.92	0.394	2.47	0.667
CV		4.81	7.61	5.20	11.27	10.61	9.33
S.O.V.	d.f.	Mean Squares					
		TN (No.)	NL (cm)	PL (mm)	SL (cm)	FN (No.)	SN (No.)
Replication	2	0.232ns	4.82*	5.54ns	0.256ns	1.661*	1.47ns
Genotype	55	4.387**	16.51**	34.78**	2.620**	3.840**	82.75**
Error	110	0.262	1.82	4.41	0.266	0.564	9.79
CV		22.06	8.96	7.47	7.26	5.75	8.91
S.O.V.	d.f.	Mean Squares					
		GN (No.)	AL (cm)	GD (mm)	GL (mm)	TS (g)	GY (kg ha^{-1})
Replication	2	0.018ns	0.040ns	0.012ns	0.084ns	0.104ns	2958.6ns
Genotype	55	0.448**	3.563**	0.125**	0.393**	5.449**	3591914.1**
Error	110	0.157	0.171	0.053	0.179	0.081	16584.7
CV		14.30	10.36	7.78	6.52	7.55	25.61

S.O.V. Sources of variation, d.f. Degrees of freedom

** Significant on 0.01 level,* Significant on 0.05 level and ns: Non-significant.

DF, the number of days to anthesis or flowering; SD, stem diameter; PH, plant height; LN, leaf number at flowering; LL, flag leaf length; LW, flag leaf width; TN, tiller number; NL, internode length; PL, peduncle length; SL, spike length; FN, floret number per spikelet; SN, spikelet number; GN, grain number per spike; awn length; GD, grain diameter; GL, grain length; TS, thousand seed weight; GY, grain yield.

Table 3. Mean values for DF, the number of days to anthesis or flowering; SD, stem diameter; PH, plant height; LN, leaf number at flowering; LL, leaf length of flag length; LW, leaf width of flag length; TN, tiller number; NL, internode length; PL, peduncle length traits

	DF (day)	SD (mm)	PH (cm)	LN (No.)	LL (cm)	LW (cm)	TN (No.)	NL (cm)	PL (mm)
G1	88.00	2.83	75.29	5.33	14.94	9.50	2.67	11.93	29.41
G2	86.67	3.23	70.20	4.67	17.81	8.33	1.33	13.51	28.07
G3	89.33	2.83	64.71	5.67	13.73	7.37	2.33	19.30	29.27
G4	87.00	3.80	70.59	5.33	15.85	10.33	6.00	13.33	29.60
G5	88.00	3.77	64.71	4.33	13.56	11.33	2.00	13.86	24.50
G6	85.33	3.70	80.39	6.67	13.24	11.50	1.67	14.56	21.69
G7	86.00	3.33	76.47	5.33	15.53	9.00	2.67	16.67	29.04
G8	84.33	3.27	74.51	6.00	15.20	8.67	5.00	12.81	32.74
G9	86.33	3.23	74.12	4.67	12.91	8.47	2.67	13.86	30.81
G10	86.67	3.93	72.16	6.33	20.59	11.00	4.67	16.84	30.88
G11	85.00	3.73	65.10	6.00	12.58	9.17	1.00	14.56	26.72
G12	87.67	3.87	74.51	5.33	19.45	7.63	3.33	20.18	30.65
G13	87.67	3.67	69.02	5.00	16.83	8.00	1.33	15.26	28.07
G14	83.67	3.70	54.90	6.00	19.28	8.33	3.67	17.89	32.42
G15	86.67	3.17	63.72	5.00	16.51	10.67	3.67	12.28	22.85
G16	80.67	3.47	81.57	5.00	16.02	9.20	3.00	14.39	28.72
G17	87.67	3.40	67.84	5.00	16.18	10.73	2.33	13.16	28.20
G18	85.00	3.47	64.71	6.00	13.89	10.33	1.67	16.84	33.87
G19	82.00	3.27	80.78	6.00	12.91	8.17	3.33	19.30	33.90
G20	86.33	3.50	107.45	5.00	14.87	9.33	5.00	18.95	23.59
G21	81.67	3.23	78.82	6.33	17.81	8.70	3.33	12.63	32.28
G22	83.33	3.03	109.53	5.67	14.38	10.00	2.00	15.09	28.40
G23	81.33	3.17	82.35	7.00	16.34	8.20	1.33	12.81	28.19
G24	81.00	3.30	91.37	5.67	13.24	9.93	3.67	12.81	28.60
G25	86.33	3.37	101.96	4.33	14.87	10.33	2.67	14.56	32.97
G26	87.33	2.30	100.00	6.00	9.96	5.67	1.33	15.09	29.38
G27	86.33	3.67	89.80	4.67	10.94	9.53	2.67	14.03	27.60
G28	83.00	3.67	96.47	5.67	17.49	10.83	3.33	18.59	26.80
G29	81.67	2.30	90.59	5.67	15.85	9.13	1.33	12.63	23.66
G30	88.33	3.03	86.47	4.00	14.87	9.63	2.33	16.49	26.28
G31	84.67	2.83	78.82	7.33	11.11	7.47	2.67	17.89	36.26
G32	86.00	2.70	96.47	6.67	14.22	8.67	2.67	13.33	31.26

G33	86.67	2.33	93.33	6.00	14.87	7.17	1.33	13.51	33.49
G34	87.67	2.73	82.94	6.33	15.04	6.87	1.00	14.74	23.68
G35	83.00	3.00	95.10	6.33	15.36	10.27	1.67	14.03	28.20
G36	86.33	2.90	87.65	5.67	15.53	6.90	1.33	17.89	27.72
G37	83.33	2.93	98.43	6.00	14.71	9.13	1.33	13.33	26.27
G38	84.33	3.23	94.51	6.33	9.80	9.33	1.33	14.03	23.17
G39	83.67	3.40	83.92	6.67	13.73	9.10	2.00	12.98	30.20
G40	83.33	3.27	87.06	6.00	8.82	7.90	1.33	13.33	21.45
G41	87.67	3.47	88.63	5.00	12.75	8.97	1.00	12.28	28.87
G42	89.33	2.80	85.10	5.67	17.81	8.20	1.33	18.60	31.30
G43	86.00	3.40	76.86	5.67	12.42	7.70	2.33	16.32	30.13
G44	87.33	3.27	100.78	5.00	15.69	8.00	1.00	17.54	32.23
G45	86.67	2.70	95.29	4.67	16.51	7.33	1.00	15.44	25.92
G46	82.33	3.43	101.57	5.33	13.40	8.73	2.67	13.33	26.09
G47	83.00	3.20	85.10	5.67	16.67	10.43	4.67	15.44	27.48
G48	83.33	3.47	82.94	5.67	15.20	10.67	1.67	16.49	27.24
G49	83.33	2.07	94.90	4.67	11.11	5.67	1.00	14.39	26.31
G50	87.67	3.47	92.94	5.33	15.53	8.10	3.67	16.14	24.42
G51	86.67	2.60	80.00	4.33	22.22	7.90	1.00	13.33	26.77
G52	84.00	2.50	91.37	6.00	13.73	9.00	1.00	13.33	24.00
G53	83.33	2.63	78.04	5.33	10.78	4.47	1.33	11.58	24.73
G54	85.00	2.87	77.25	5.67	11.93	7.00	1.33	11.23	22.41
G55	85.00	3.20	92.55	5.67	11.93	7.33	2.33	18.60	29.75
G56	83.67	4.27	78.04	5.00	20.59	8.47	2.67	19.65	25.85
LSD	**0.66**	**0.39**	**7.04**	**1.02**	**2.54**	**1.32**	**0.83**	**2.18**	**3.40**

Table 4. Mean values for SL, spike length; FN, floret number per spikelet; SN, spikelet number; GN, grain number per spike; length of awn; GD, grain diameter; GL, grain length; TS, 1000-seed weight; GY, grain yield

	SL (cm)	FN (No.)	SN (No.)	GN (No.)	AL (cm)	GD (mm)	GL (mm)	TS (g)	GY (kg ha^{-1})
G1	6.75	13.67	33.00	2.67	4.24	2.71	5.98	33.25	3238.2
G2	7.37	12.67	37.00	2.67	4.11	2.61	6.35	37.24	5567.1
G3	6.53	14.00	27.00	3.00	2.25	2.63	6.61	37.01	3931.2
G4	7.82	15.00	41.33	3.33	4.52	3.32	7.45	41.69	6936.3
G5	6.87	13.33	43.33	3.00	4.74	3.20	6.10	43.22	5481.0
G6	7.33	12.67	34.33	2.67	4.76	2.79	6.56	37.93	2954.7
G7	8.08	14.33	40.33	3.33	4.28	3.29	7.08	41.44	6386.1
G8	6.76	15.33	39.67	3.00	4.79	3.05	6.70	36.55	5997.6
G9	7.26	14.00	34.00	3.00	3.36	3.01	6.47	38.92	5334.0
G10	8.64	16.00	38.33	3.00	4.56	3.05	6.75	45.52	6430.2
G11	7.22	10.33	36.67	3.00	3.77	3.05	6.22	36.33	5481.0
G12	7.61	13.33	35.33	3.00	6.53	2.66	5.91	27.32	3357.9
G13	6.14	14.67	41.00	3.00	1.32	2.94	6.18	30.67	4120.2
G14	8.03	12.00	35.67	3.00	5.68	3.11	6.61	37.66	4930.8
G15	6.34	13.33	29.00	2.67	2.82	3.04	6.06	34.20	3649.8
G16	6.99	14.00	33.00	3.00	3.07	2.90	6.70	39.82	3399.9
G17	8.11	12.33	39.33	2.33	5.13	2.98	7.05	40.07	5808.6
G18	8.02	16.33	39.33	3.00	4.47	3.34	6.61	38.42	5680.5
G19	6.07	14.33	36.00	3.00	0.77	3.04	7.10	41.12	5254.2
G20	8.44	19.00	44.00	3.00	4.94	2.89	6.67	37.31	5720.4
G21	8.69	13.00	40.67	3.00	5.26	3.27	6.57	41.68	5153.4
G22	7.42	11.67	39.00	3.00	3.98	3.13	6.47	40.88	4250.4
G23	6.64	12.33	33.00	3.00	3.80	2.69	6.12	38.48	3387.3
G24	6.73	14.00	43.00	3.00	4.06	3.21	6.36	42.68	5100.9
G25	8.39	15.33	54.67	3.67	4.46	3.05	6.79	38.97	5457.9
G26	6.19	8.33	28.33	2.33	3.33	2.89	6.53	39.00	3187.8
G27	6.27	13.33	39.00	3.00	4.21	2.83	6.42	39.15	5663.7
G28	8.95	15.67	37.00	3.00	5.32	3.08	6.93	36.33	5869.5
G29	6.40	10.33	30.67	2.67	3.14	3.04	6.19	38.63	3210.9
G30	7.84	10.67	30.33	2.00	4.14	2.99	6.36	40.56	5877.9
G31	5.02	15.00	31.33	2.33	1.35	2.98	6.80	39.47	5273.1

G32	8.54	14.33	35.00	2.67	4.58	3.08	6.12	43.24	5915.7
G33	4.86	11.00	28.67	2.00	0.83	3.19	6.95	41.08	4737.6
G34	6.16	7.67	34.33	3.00	4.61	2.83	5.92	33.97	4218.9
G35	7.27	13.00	39.33	3.00	4.31	2.86	6.38	36.48	5812.8
G36	6.65	10.67	28.33	2.33	4.17	2.43	5.59	26.56	3481.8
G37	6.82	10.67	32.33	2.33	4.29	2.94	6.32	31.02	5613.3
G38	6.45	13.33	33.33	3.00	3.18	2.73	6.41	31.13	3521.7
G39	6.47	15.67	38.33	3.00	4.62	2.76	5.72	33.90	5163.9
G40	4.74	12.67	32.67	2.67	3.72	3.08	6.37	34.01	4424.7
G41	6.91	13.33	33.33	2.33	3.80	2.91	6.50	42.51	6087.9
G42	7.05	10.67	26.00	2.00	4.34	2.63	6.55	30.60	3343.2
G43	7.57	13.33	37.00	3.00	4.47	3.03	7.01	41.51	5527.2
G44	7.38	11.00	35.33	2.67	4.52	3.24	6.95	41.08	6029.1
G45	7.02	13.67	31.00	2.67	3.91	3.06	6.51	33.18	3538.5
G46	7.75	13.00	30.33	2.67	3.40	2.92	6.40	40.15	5770.8
G47	8.35	14.00	36.00	3.00	5.37	3.08	6.63	39.67	6394.5
G48	7.59	16.67	41.67	3.33	4.51	3.20	6.39	37.23	5966.1
G49	6.65	11.67	33.33	2.33	4.35	2.73	6.87	37.94	6163.5
G50	6.63	13.33	29.67	2.67	3.96	2.76	6.55	34.86	4134.9
G51	7.88	9.67	27.33	2.00	4.05	2.70	6.30	40.06	4130.7
G52	7.34	12.00	32.33	2.33	3.80	2.71	6.25	38.74	5766.6
G53	6.12	9.00	29.00	2.00	3.61	3.10	6.39	43.26	5187.0
G54	6.02	12.00	33.33	2.67	4.08	3.00	6.39	33.51	6186.6
G55	7.84	12.67	31.33	2.33	4.26	3.19	6.97	45.57	6260.1
G56	6.80	15.67	33.33	3.33	3.45	3.01	6.22	36.78	6274.8
LSD	**0.83**	**1.21**	**5.06**	**0.64**	**0.67**	**0.37**	**0.68**	**3.46**	**208.4**

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