EVALUATION PERFORMANCE OF BREAD WHEAT PURE LINES TO GROWTH TRAITS AND PROLINE

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ABSTRICT

A field experiments were carried out at Abu- Graib Research Station- Agricultural Research Office- Ministry of Agriculture during 2014- 2015 season to investigate the performance of 225 pure lines of bread wheat (*Triticum aestivum* L.), which at sixth generation after crossing among local and exotic genotypes (during 2008 to 2014) with their parents. The experiment was conducted using Simple Lattice Design with three replications. The results were revealed highly significant differences among genotypes for all studied traits. The genotypes 39 and 192 had higher number of days to 50% flowering (140 days), the longest period of physiological maturity 159 days of genotype 49. The highest means of flag leaf area (80.4 cm^2) were found by genotype 199, the genotype 101 gave higher flag leaf angle (72^0), the genotype 28 gave higher plant height (94.6 cm), higher number of tillers (47.4 tillers) produced by genotype 99, genotype 207 gave higher length of spike (19.3 cm). The genotype 156 superior in number of spikelet spike^{-1} and highest proline content (6.91 µ moles mg^{-1}) in flag leaf was found in genotype 39.

Key words: genotypes, flowering, maturity, flag leaf angle, flag leaf area.
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تقويم اداء خطوط نقية من حنطة الخبز لصفات النمو والبرولين

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المستخلص

نفذت تجربة حقلية في حقول محطة ابحاث ابي غريب، دائرة البحوث الزراعية– وزارة الزراعة خلال الموسم الشتوي 2014–2015 بهدف غربلة 225 خطا نقيا من حنطة الخبز (*Triticum aestivum* L.) في جيلها السادس والناتجة من التضريب بين الاصناف المحلية والتراكيب المدخلة (خلال الفترة من 2008 الى 2014) اضافة الى ابائها واصناف المقارنة. طبقت التجربة بالتصميم الشبكي البسيط وبثلاثة مكررات. اظهرت نتائج التحليل الاحصائي وجود اختلافات معنوية بين التراكيب الوراثية ولجميع الصفات المدروسة حيث تفوق التركيبين الوراثيين 39 و192 باعطائهما اعلى عدد لايام 50% تزهير (140 يوم)، واطول مدة للنضج الفسلجي سجله التركيب الوراثي 49 (159يوم) واعلى متوسط لمساحة ورقة العلم سجله التركيب الوراثي 199 وكانت 80.4 سم^2 واعلى قيمة لزاوية ورقة العلم حققها التركيب الوراثي 101 بلغت 720 درجة واعلى ارتفاع للنبات سجله التركيب الوراثي 28 (94.6 سم) واعلى عدد للاشطاء حققها التركيب الوراثي 99 وكانت 47.4 شطأ واعلى طول للسنبة سجله التركيب الوراثي 207 بلغ 19.3 سم واعلى عدد من السنيبلات بالسنبلة حققه التركيب الوراثي 156 وكانت 25.6 سنيبلة سنبلة$^{-1}$ واعلى محتوى من البرولين في ورقة العلم سجله التركيب الوراثي 39 بلغ 6.91 مايكرو مول ملغم$^{-1}$.

كلمات مفتاحية: تراكيب وراثية، ازهار، النضج، زاوية ورقة العلم، مساحة ورقة العلم.

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INTRODAUCTION

Bread wheat (*Triticum aestivum* L), one of the most important cereal crops in the world and Iraq. More than 33% of the world population are use wheat as main food, (27). This crop cultivate and harvest during the year at the world. Wheat breeding programs are design to identify genotypes possessing improve grain yield adaptation to chancing climatic conditions.Wheat could be cultivate from the north to the south of Iraq, this country yearly need 3.25 million tones, but it's production not more than 2 million tones yearly (8). Natural genetic variations induced from genetic materials, environment and their interaction. Any population genetically improvement depend on the genetic variation within the same population or using mutation induction, introduction from other regions hybridization between different strains of the same species and more useful when they have highest genetic diversity. Hybridization is the best way to get genetic variation in second generation as new gene recombination, breeder can select promising genotypes from segregated generation to develop new pure lines and varieties in the future, which superior in yield, yield components and some other desirable characters .Hybridizations are important breeding method to develop inbred lines and hybrids in the cross pollinated crops, and resources of new recombination. The selection after crossing in wheat could be carried out according to the aim of crossing, in the most cases improving one or more yield components to develop grain yield. The successfully of selection generally depend to the genetic variation of the segregated generation, which increase the chance of improvement and development promising genotypes. There are different procedures of selection, mass selection, pure line selection, inbred line selection and spike per row selection, (26). The Biological Scientist Johannnson, during 1903 - 1926, he developed pure line selection, using self pollinated crops and he was found that the selection was useless in pure lines (13). Allard (7) defined the selection is the picking out plants with desired traits from the heterogametic population. In general selection and it's successful depend on additive gene action, selection could be done to increase favorable genes for desired characters and applied until reducing the genetic gain (15). Selection could be increases the frequency of favorable genes for the studied traits, which causes the improvement of those traits (6, 11, 12). Selection program for local genotypes undesirable because those genotypes were highly homozygous pure lines, for the improvement of local genotypes must be induce genetic variations. The objective of this research, hybridization among local and exotic genotypes and application of pure line selection for the superior lines, which adapted to water stress (25).

MATERIALS AND METHODS

Field experiments were conducted at the Research Station- Office of Agricultural Research- Ministry of Agriculture, during 2014 - 2015, using genotypes developed from crossing exotic and local genotypes. Selection, spike- row were carried out for six generations. Selected plants in 7^{th} generation, their parents and local varieties, were evaluated, (Table 1, 2). Varietal trail was conducted, using 225 genotypes, within Simple Lattice Design (15 x 15) with three replicates. Each replicate was contained 15 plots with 15 rows, row spacing was 0.50 m. and 0.25 m. within the row. The experiment was conducted at the loam clay soil, (Table 3). Soil of the experimental field fertilized with 100 $kg.ha^{-1}$ superphosphate, (P_2O_5), which added before field preparation. Nitrogen fertilizer as urea (46% N) was added with quantity 200 $kg.ha^{-1}$, two times: before planting and booting stage, soil samples were took from 30 cm depth and analyzed for chemical and physical characteristics of the soil (Table 3). Different growth observations were recorded; Number of days from planting to 50% flowering, number of days from planting to physiological maturity, plant height (cm), number of tillers. $plant^{-1}$, flag leaf area cm^{-2}, flag leaf angle. spike length cm^{-1}, number of spikelets. $spike^{-1}$. proline content ($Micromole.gm^{-1}$). The results were analyzed statistically, using analysis of variance. The means were compared using LSD 5 %, by statistical program, Genestate.

RESULTS AND DICUSSION

Number of days from planting to flowering and physiological maturity:

The results of the Table 4 shows significant differences among wheat genotypes in number of days from planting to 50% flowering. The genotype 28 was earlier than others in flowering, it was grossed in 103 days. While, both genotypes 39 and 192 were needed long period for flowering (140 days), but the differences non significant between both genotypes. This results conform with results of Al-Anbari, Al-Temimi (5), Nassan (19) and Naes (28). The variation among genotypes due to differences in genetic materials among those genotypes.

Table 1. Genotypes, crosses and their hybrids.

Number	Genotypes	Cross	Number	Genotypes	Cross
1	H4P	IPA99 x Indai9	17	H10p	Fatah x Abu- Graib3
2	H5P	IPA99 x Indai9	18	S102	A3013 x Fatah
3	H6P	Mexipak x Indai9	19	S13	M.2 x Fatah
4	H7P	IPA95 x Indai7	20	S52	IPA99 x Fatah
5	H8P	Indai9 x Mexipak	21	S175	A4.10 x Fatah
6	H9P	IPA95 x Mexipak	22	S118	Abu- Graib3 x Fatah
7	H10P	Abu- Graib3 x Sham6	23	S23	M.2 x A3103
8	H11P	Indai9 x Sham6	24	S83	IPA99 x A3103
9	H12P	IPA95 x Abu- Graib3	25	S148	A4.10 x A3103
10	H13P	Fatah x IPA95	26	S152	Abu- Graib3 x A3103
11	H14P	Indai9 x IPA99	27	S94	IPA99 x M.2
12	H15P	Abu- Graib3 x Fatah	28	S97	A4.10 x M.2
13	H2p	IPA99 x IPA95	29	S76	Abu- Graib3 x M.2
14	H5p	Fatah x IPA95	30	S130	A4.10 x IPA99
15	H6p	Fatah x IPA95	31	S46	Abu- Graib3 x IPA99
16	H8p	IPA99 x IPA95	32	S123	Abu- Graib3 x A4.10

The results of the Table 4, also reveal a significant differences among genotypes in number of days from planting to physiological maturation, the genotype 49 grossed in highest number of days to physiological maturity, it was grossed in 159 days, and didn't differs from several other genotypes. While, the genotypes 85, 97 and 146 earlier than other's (152 days), at the same time didn't significantly differs from several other genotypes. The results of this experiment conform with the results of Al-Temimi (5), Hassan (9) and Naes (28). The differences in the means of the number of days from planting to maturity, due to differences in genetic composition and there interaction with the environment.

Flag leaf area and flag leaf angle:

A significant differences were found among wheat genotypes in the character of flag leaf area (Table 4). The plants of the genotype 199 had highest flag leaf area (80.4 cm^2). The lowest leaf area (36.3 cm^2) were produced from the plants of the genotype 125. This trait under additive gene action and sometimes miner genes also, effect indirect to the flag leaf area (22). These results agreed with the results of, Al-Essel (3), Mohammed (26) and Naes (28). Plants flag leaf area, very important character to plant growth and production, because this leave more physiologically active part of the plant, as manufacturer area for dray matter by photosynthesis. Leaf distribution around the wheat plants stem had related with the quantity of sun shine which penetrate to the more leaf area, specially it's angle with stem. Flag leaf was at the top leaves of the wheat plant, so it's angle very important for light penetration to other leaf area and it's relation for photosynthesis and dray matter accumulation. Table 4 shows, significant differences among genotypes in means of flag leaf angle, the genotype 101 had largest flag leaf angle (72.0 degree), while the genotype 67 had narrow flag leaf angle (30.5 degree), this narrowest very important for the production of population, which can plant with highest seeds rate in cultivation. the results of this experiment agreed with results of, Kang (21), Naes (28) and Simon (31).

Table 2. Parents and selected genotypes from previous experiments which, evaluated during season 2014 - 2015.

No.	Gen.	No.	Gen.	No.	Gen.	No.	Gen.	No.	Gen.
1	IPA99	**51**	H6P3-1	**101**	H10P1-1	**151**	H12P6-5	**201**	H8-2
2	India 8	**52**	H6P3-2	**102**	H10P1-2	**152**	H12P7-1	**202**	H8-3
3	India9	**53**	H6P3-3	**103**	H10P1-3	**153**	H12P7-2	**203**	H8-4
4	IPA95	**54**	H6P3-4	**104**	H10P2-1	**154**	H12P7-3	**204**	H8-5
5	Mexipak	**55**	H7P1-1	**105**	H10P2-2	**155**	H12P7-4	**205**	H10-1
6	India7	**56**	H7P1-2	**106**	H10P2-3	**156**	H12P7-5	**206**	H10-2
7	Sham6	**57**	H7P1-3	**107**	H10P2-4	**157**	H13P1-1	**207**	H10-3
8	Abu- Grb	**58**	H7P1-4	**108**	H10P2-5	**158**	H13P1-2	**208**	H10-4
9	Fatah	**59**	H7P1-5	**109**	H11P2-1	**159**	H13P1-3	**209**	S102
10	AL-fatah	**60**	H7P2-1	**110**	H11P2-2	**160**	H13P1-4	**210**	S13
11	A3103	**61**	H7P2-2	**111**	H11P2-3	**161**	H13P1-5	**211**	S52
12	M.2	**62**	H7P2-3	**112**	H11P2-4	**162**	H13P1-6	**212**	S175
13	IPA99	**63**	H7P2-4	**113**	H11P2-5	**163**	H14P1-1	**213**	S118
14	A4.10	**64**	H7P2-5	**114**	H11P3-1	**164**	H14P1-2	**214**	S23
15	Abu- Graib3	**65**	H7P3-1	**115**	H11P3-2	**165**	H14P1-3	**215**	S83
16	H4P2-1	**66**	H7P3-2	**116**	H11P3-3	**166**	H14P1-4	**216**	S148
17	H4P2-2	**67**	H7P4-1	**117**	H11P3-4	**167**	H14P1-5	**217**	S152
18	H4P2-3	**68**	H7P4-2	**118**	H11P3-5	**168**	H15P1-1	**218**	S94
19	H4P2-4	**69**	H7P4-3	**119**	H11P4-1	**169**	H15P1-2	**219**	S97
20	H4P2-5	**70**	H7P4-4	**120**	H11P4-2	**170**	H15P1-3	**220**	S76
21	H4P3-1	**71**	H7P4-5	**121**	H11P4-3	**171**	H15P1-4	**221**	S130
22	H4P3-2	**72**	H7P5-1	**122**	H11P4-4	**172**	H15P1-5	**222**	S46
23	H4P3-3	**73**	H7P5-2	**123**	H11P4-5	**173**	H15P2-1	**223**	S123
24	H4P3-4	**74**	H7P5-3	**124**	H11P4-6	**174**	H15P2-2	**224**	Saberbak
25	H4P3-5	**75**	H7P5-4	**125**	H11P4-7	**175**	H15P2-3	**225**	Bohoth 22
26	H4P4-1	**76**	H7P5-5	**126**	H11P4-8	**176**	H15P2-4		
27	H4P4-2	**77**	H7P6-1	**127**	H12P1-1	**177**	H15P2-5		
28	H4P4-3	**78**	H7P6-2	**128**	H12P1-2	**178**	H15P3-1		
29	H4P4-4	**79**	H7P6-3	**129**	H12P1-3	**179**	H15P3-2		
30	H4P4-5	**80**	H7P6-4	**130**	H12P1-4	**180**	H15P3-3		
31	H5P1-1	**81**	H7P6-5	**131**	H12P1-5	**181**	H15P3-4		
32	H5P1-2	**82**	H8P1-1	**132**	H12P2-1	**182**	H15P3-5		
33	H5P1-3	**83**	H8P1-2	**133**	H12P2-2	**183**	H15P3-6		
34	H5P1-4	**84**	H8P1-3	**134**	H12P2-3	**184**	H15P3-7		
35	H5P1-5	**85**	H8P1-4	**135**	H12P2-4	**185**	H2-1		
36	H5P3-1	**86**	H8P1-5	**136**	H12P2-5	**186**	H2-2		
37	H5P3-2	**87**	H8P1-6	**137**	H12P4-1	**187**	H2-3		
38	H5P3-3	**88**	H8P1-7	**138**	H12P4-2	**188**	H2-4		
39	H5P3-4	**89**	H9P1-1	**139**	H12P4-3	**189**	H2-5		
40	H5P3-5	**90**	H9P1-2	**140**	H12P4-4	**190**	H5-1		
41	H6P1-1	**91**	H9P1-3	**141**	H12P4-5	**191**	H5-2		
42	H6P1-2	**92**	H9P1-4	**142**	H12P5-1	**192**	H5-3		
43	H6P1-3	**93**	H9P1-5	**143**	H12P5-2	**193**	H5-4		
44	H6P1-4	**94**	H9P1-6	**144**	H12P5-3	**194**	H5-5		
45	H6P1-5	**95**	H9P1-7	**145**	H12P5-4	**195**	H6-1		
46	H6P2-1	**96**	H9P3-1	**146**	H12P5-5	**196**	H6-2		
47	H6P2-2	**97**	H9P3-2	**147**	H12P6-1	**197**	H6-3		
48	H6P2-3	**98**	H9P3-3	**148**	H12P6-2	**198**	H6-4		
49	H6P2-4	**99**	H9P3-4	**149**	H12P6-3	**199**	H6-5		
50	H6P2-5	**100**	H9P3-5	**150**	H12P6-4	**200**	H8-1		

Plant height (cm) and Number of tillers. plant^{-1}:

The results in the Table 4, shows significant differences among wheat genotypes in plant height. The genotype 28 produced tallest plants in this experiment, in the average 94.6 cm, while the genotype 188 produced the shortest plants it was 41.5 cm. the reason of those differences was the influence of pair genes (Rht1), which response from dwarf characters, also the wide spacing between plants causes large light inter between plants and this reduced elongation of the plants at elongation time, (14, 18, 33). these results conform with results of Al-Baldawi (2), Al-Essel (3) and Salman and Mahdi (30). The plant height variation among genotypes due to internodes variation especially the uppers of the middle plant length, and this variation inverse of the differences in genetic materials among genotypes used in this experiment. In wheat plant cultivars spikes population depend on the tillering processes more of the plants produce tillers with higher number of barren spikes.

Table 3. Some chemical and physical soil characters of the experimental field for the season 2014 -2015.

Soil characters	Units	
pH		7.0
Soil EC.	ds m^{-1}	2.3
Water EC.	Dece semen's m^{-1}	2.56
Available N.	$Mgkg^{-1}$	15.1
Available P	$Mgkg^{-1}$	16.61
Available K	$Mgkg^{-1}$	360
Organic matter %		0.771
Bulk density	Mgm^{-3}	1.30
Clay	$Mg.kg^{-1}$soil	204
Silt	$Mg.kg^{-1}$soil	508
Sand	$Mg.kg^{-1}$soil	288
Texture		Loamy
Field Capacity		0.30
Permanent wilting point	Pwp	0.15
Available water		0.15

Tillering activity in wheat continue to the end of booting stage, at this stage the highest number of fertile tillers could be found. Number of tillers one of the wheat grain yield component, which differs due to genotypes and environment and their interaction. The results in Table 4 shows significant differences among genotypes in the number of tillers $plant^{-1}$. The plants of the genotype 99 produced highest average number of $tillers.plant^{-1}$ (47.4 $tillers.plant^{-1}$), while the lowest average number of tillers. $plant^{-1}$ (15.0 tillers) produced from the plants of the genotype 216, (28). The reason of differences among genotypes in number of $tillers.plant^{-1}$ due to differences in genetic materials. The results of this experiment are conform with the results of Amer (9) and Mer and Ama (30). The genotypes with the highest number of tillers. $plant^{-1}$ can be within the lowest seeding rate and the lowest number of tillers with highest seeding rate.

Spike length and number of $spikelet.spike^{-1}$

The spike length and number of $spikelet.spike^{-1}$, are sub grain yield of wheat, both of related to the number of grains. $spike^{-1}$. A significant differences were found among genotypes in this experiment, (Table 4). The plants of the genotype 207 produced longest spike length (19.3 cm), while the shortest (10.0 cm) spike length produced from the plants of the genotypes 64 and 111. The reason of those variation due to differences in genetic materials among genotypes which used in this experiment. The results of the Table 4, shows significant differences among genotypes used in this experiment, in number of spikelets. $spike^{-1}$. The average number of the spiketes. $spike^{-1}$ were 16.5- 25.6 spikelets, those variation due to differences in genetic materials of the genotypes and it's affect by the environment there interaction, (16). The results of this experiment agreed with results of Al-Anbarey (1) Al-Hassan (4), Hamdan et al (17), Kadom (20), Mohammed (26) and Makpool et al (24).

Proline ($micro.mol.mg^{-1}$):

Proline one of the free amino acids, it's content secondary related groups, this character and it's accumulation differentiated proline from other amino acids. This amino acid has relation with osmoses in the cell and concentrated in the cytoplasm to equilibrium of osmoses stress. Table 4 reveal a significant differences among genotypes in flag leaf area proline content. The wheat plants of the genotype 39 content highest proline. The lowest (5.79 $micro.mol.mg^{-1}$) proline content was found in the flag leaf of the genotype 163 plants. The reason of the variation of proline content of the plants of genotypes, due to genetic materials difference in those genotypes, (4, 32)

Table 4. Means of growth traits and prolen for the season 2014- 2015 .

Genotypes	Days to flowering	Days to maturity	Flag leaf area cm^2	Flag leaf angle	Plant height cm	No.tillers. $plant^{-1}$	Spike lenth cm	No.spiklets $^{-}spike^{-1}$	Prolen
1	128	156	55.7	43.5	70.0	34.5	12.5	18.6	6.09
3	133	154	45.0	48.0	47.6	24.6	12.8	20.6	6.09
4	131	154	60.9	45.0	73.5	23.9	14.8	22.3	6.33
5	122	154	44.8	42.5	75.3	26.0	13.7	20.7	6.08
6	124	154	55.8	55.5	64.0	27.5	12.4	21.0	6.10
7	133	156	49.2	48.0	55.3	25.6	11.4	19.3	6.03
8	120	156	47.0	59.0	69.0	31.8	12.7	19.7	6.89
9	132	157	61.3	44.5	49.0	35.1	13.0	21.7	6.23
10	129	158	58.2	41.5	70.3	**45.1**	12.9	21.3	6.32
11	122	154	62.5	40.0	75.5	42.0	11.5	20.3	5.90
12	129	154	56.3	50.0	72.5	40.8	12.0	20.3	6.17
13	128	155	71.1	48.5	58.5	24.0	12.0	21.0	6.27
14	132	154	64.6	46.5	68.2	35.1	13.5	20.6	6.04
15	129	153	47.3	45.5	70.6	33.0	13.4	20.3	6.50
16	131	154	50.7	44.5	90.3	27.4	13.7	20.5	5.98
17	125	153	40.9	41.5	87.2	22.5	11.7	21.3	6.18
18	135	158	59.1	53.0	65.3	21.9	12.9	21.0	6.24
19	136	158	48.3	41.0	66.6	35.5	13.7	21.7	6.04
20	122	158	72.3	52.5	58.5	21.0	14.2	20.0	6.18
21	130	156	50.8	46.5	79.2	35.5	13.5	21.0	6.23
22	131	155	55.2	48.5	81.1	24.9	13.5	21.0	6.17
24	128	156	45.8	50.5	79.3	25.6	12.8	19.6	6.19
26	129	156	55.0	49.0	78.0	27.1	12.4	19.0	6.14
27	122	154	59.2	41.5	82.0	32.5	14.2	21.3	5.98
28	103	158	47.3	50.5	**94.6**	19.6	17.0	23.3	5.87
29	133	155	51.3	40.0	69.5	32.4	12.8	21.0	6.22
30	137	158	54.6	56.0	77.3	17.8	12.9	20.0	6.12
32	132	158	43.9	53.5	93.4	19.0	18.8	18.5	6.15
33	122	154	41.6	43.0	71.6	21.1	17.7	19.7	6.05
34	134	156	53.9	48.0	59.1	24.5	13.0	20.3	6.04
35	133	157	52.9	41.0	72.6	26.2	13.9	21.7	6.00
36	122	154	51.4	56.5	80.3	26.0	11.9	18.6	6.21
37	134	157	58.6	54.0	73.3	41.2	12.4	21.0	6.15
38	122	154	59.0	35.5	72.0	27.4	12.9	20.6	6.10
39	**140**	158	36.8	38.5	64.0	27.4	16.2	22.3	**6.91**
40	133	158	43.9	40.0	67.0	45.2	13.7	20.3	6.33
41	137	158	66.2	45.0	79.7	34.2	13.5	20.3	6.17
42	123	156	74.4	58.5	87.6	27.4	14.7	22.0	5.99
43	129	153	54.2	47.0	69.8	23.7	13.2	21.3	6.34
44	129	157	58.0	50.5	66.3	32.2	13.7	21.3	5.95
45	123	153	60.3	53.0	76.0	21.9	13.2	20.3	5.99
46	138	157	57.8	37.5	72.1	42.9	10.3	18.0	5.98
47	125	154	40.4	42.5	59.1	31.5	13.3	22.7	5.90
49	138	**159**	69.1	44.0	75.8	18.4	12.7	20.3	5.93
50	122	154	60.9	39.5	67.0	42.0	10.9	17.4	6.06
51	131	158	62.9	44.0	68.0	35.5	12.5	21.6	6.23
52	129	156	62.4	47.5	76.0	19.4	13.5	22.0	6.27
53	130	156	50.5	39.0	91.3	26.7	15.0	22.0	6.33
54	122	153	59.4	48.0	76.3	21.4	12.0	18.0	6.00
55	129	153	38.9	46.0	55.1	30.6	12.7	21.0	6.06
56	133	158	52.3	54.0	52.8	19.5	12.5	19.3	6.40
57	123	153	40.1	42.5	69.3	31.0	12.0	19.0	6.05
58	136	157	64.5	44.0	73.8	25.3	12.7	**16.5**	5.95
59	135	158	54.7	50.5	69.6	28.5	13.2	20.0	6.16
60	133	157	68.4	49.0	82.1	30.4	12.9	21.3	6.44
61	131	153	45.7	43.0	59.5	35.7	12.8	21.0	6.10
62	126	154	51.9	44.0	68.3	29.9	11.5	21.0	5.94
63	133	158	59.8	49.0	76.1	22.6	11.8	21.3	6.01
64	127	156	51.4	49.0	51.5	31.5	**10.0**	19.0	6.22
65	131	154	48.8	46.0	64.5	23.9	12.7	19.6	5.98
66	127	155	53.8	46.5	66.9	28.2	11.5	18.3	6.04
67	128	156	54.3	**30.5**	75.5	35.0	13.3	20.0	6.11
68	130	154	43.6	46.5	70.7	25.9	13.2	20.7	6.34
69	128	156	48.7	39.0	67.7	33.1	13.7	21.3	6.19
70	133	157	68.0	56.0	63.0	33.0	12.9	19.0	6.03

71	135	156	51.0	39.5	67.5	33.8	12.8	21.7	6.19
72	132	156	56.6	44.0	81.8	33.2	13.0	21.3	6.11
73	129	154	54.8	42.0	54.2	28.5	12.2	21.3	6.01
74	122	153	42.7	51.5	55.1	26.0	13.3	21.3	6.05
75	128	153	47.6	34.0	80.3	36.4	13.7	20.7	6.27
76	133	158	53.7	45.5	76.3	45.5	12.0	21.9	6.17
77	130	154	48.7	46.0	60.1	23.6	12.7	21.6	6.16
78	123	154	53.5	49.0	74.5	28.4	13.0	21.0	6.31
79	132	154	51.1	44.0	67.8	25.2	12.7	21.0	5.96
80	134	156	52.0	41.0	78.6	16.1	13.5	20.3	6.11
81	133	153	64.6	49.5	67.5	36.2	11.8	20.7	6.11
82	133	156	48.8	46.5	71.0	18.4	12.0	21.0	6.00
83	132	154	46.0	54.5	76.0	26.4	11.9	21.0	6.34
84	123	154	52.6	49.0	70.1	31.6	14.4	22.3	6.47
85	121	**152**	49.9	37.5	68.2	33.3	10.5	20.3	5.98
86	134	154	59.0	51.5	75.5	38.5	11.8	20.0	6.19
87	120	153	47.5	52.5	73.0	27.2	13.7	20.6	5.87
90	130	155	54.6	52.5	69.1	43.1	13.0	20.0	6.01
91	128	154	63.7	51.0	74.7	25.1	13.0	21.3	6.12
92	132	154	45.6	50.0	65.0	37.4	12.8	21.6	6.21
93	128	154	64.3	41.0	64.5	33.1	12.2	20.3	6.06
94	125	154	55.2	44.5	77.6	27.2	11.8	19.6	6.18
95	125	153	54.2	52.5	75.8	30.6	13.7	21.6	6.20
96	130	154	56.5	41.5	72.3	29.6	12.9	20.0	6.29
97	122	**152**	53.3	43.0	83.8	33.8	12.2	21.3	5.95
98	127	154	61.1	44.5	64.1	36.0	11.7	20.0	6.02
99	122	155	49.0	51.0	60.1	**47.4**	12.9	18.6	5.93
100	126	153	46.0	37.5	74.2	35.8	12.5	22.7	5.87
101	128	155	55.1	**72.0**	79.3	36.5	13.2	21.3	5.86
102	133	153	62.6	51.5	57.8	26.4	14.0	19.3	6.16
103	122	154	50.5	48.0	64.8	25.7	13.5	22.3	5.98
104	128	153	48.2	47.5	73.3	24.4	12.7	19.0	6.17
105	131	154	54.2	56.5	73.9	21.5	11.8	20.3	6.30
106	123	153	44.1	61.0	78.5	27.4	13.2	20.3	5.91
107	122	153	44.5	54.5	74.0	30.2	12.9	20.0	5.91
108	126	153	44.8	41.5	55.0	30.8	14.5	19.7	5.98
109	119	154	56.6	42.5	65.3	37.0	11.5	19.6	6.07
110	122	156	56.7	54.0	70.5	36.1	11.9	18.2	6.11
111	128	157	44.2	51.5	62.6	25.0	**10.0**	18.0	5.89
112	128	156	45.3	56.0	74.6	34.2	13.7	20.6	6.14
113	121	155	43.6	36.5	75.1	44.5	12.5	20.0	6.08
114	124	154	58.3	52.5	76.6	33.4	12.9	22.3	6.19
116	138	158	47.5	53.5	75.8	24.8	11.8	20.0	6.40
117	133	156	48.5	56.0	81.5	17.9	10.7	19.3	6.12
118	117	154	42.9	49.0	64.1	29.8	13.6	21.3	6.37
119	122	154	52.4	54.5	74.1	26.6	11.7	19.6	6.36
120	121	154	45.2	67.5	62.8	26.0	11.0	20.3	6.07
121	123	156	53.4	53.5	78.5	21.6	12.7	19.7	6.03
122	131	154	69.5	51.0	74.2	33.9	11.9	21.0	6.12
124	121	155	38.9	45.0	77.1	36.5	13.3	21.3	6.25
125	121	156	**36.3**	49.0	73.6	22.9	10.5	19.3	5.87
126	121	155	46.3	44.0	72.5	44.5	11.9	20.0	5.92
128	124	153	45.8	44.5	75.8	36.0	13.2	19.3	5.90
129	127	154	51.0	47.5	68.1	24.1	14.2	22.3	5.92
130	121	154	45.2	62.5	74.8	22.2	14.3	22.6	6.15
131	119	154	46.0	51.5	75.6	30.8	13.2	20.3	5.94
132	125	154	40.4	33.5	67.0	21.4	12.0	20.3	5.92
133	133	154	59.3	42.5	67.1	29.2	10.9	20.0	6.08
134	135	157	39.9	36.5	49.3	34.6	13.0	22.6	5.98
136	134	158	58.2	46.0	76.6	26.2	14.0	20.3	6.39
137	121	153	44.5	51.5	54.0	32.4	12.0	19.3	5.98
138	123	154	58.0	58.5	74.8	28.1	11.9	19.7	5.91
140	133	154	63.8	46.5	72.3	27.4	13.0	20.3	6.46
141	131	155	54.6	58.5	69.8	28.4	12.0	21.3	5.91
142	128	154	69.6	43.5	64.8	28.9	11.9	20.3	5.89
143	134	157	59.2	41.5	70.7	26.2	12.5	20.6	6.30
144	131	153	57.0	44.0	66.8	41.9	12.0	20.7	5.96
145	132	154	56.6	48.5	71.5	29.1	13.0	21.3	6.40
146	126	**152**	50.5	55.0	71.0	31.5	12.0	22.0	6.09
147	121	154	53.5	55.5	68.5	27.4	14.8	21.3	5.95

148	122	154	50.6	54.0	73.0	16.0	12.8	19.9	6.21
149	127	155	44.6	48.5	72.3	19.4	13.0	21.0	6.09
150	134	156	58.7	52.5	68.6	44.9	12.2	20.7	6.29
151	119	153	54.7	34.5	74.3	23.4	11.7	20.0	5.96
152	127	154	71.6	45.5	64.6	29.6	12.5	22.3	6.33
153	131	156	59.0	44.0	70.8	25.4	13.5	23.0	6.12
154	130	156	46.5	36.5	79.0	35.2	13.2	21.6	6.20
155	132	153	58.7	54.5	73.5	27.4	12.5	21.3	6.14
156	127	156	51.0	53.0	71.0	16.4	14.0	20.3	6.28
158	132	156	54.8	48.5	83.5	35.1	12.9	**25.6**	5.97
159	133	154	70.2	47.5	77.6	31.5	13.3	19.3	6.40
160	131	156	60.5	41.0	58.2	25.3	14.5	21.6	5.93
161	131	155	52.1	38.0	76.0	31.6	13.9	22.3	5.98
162	131	154	57.5	49.0	57.8	28.9	12.7	21.3	6.40
163	128	154	59.9	58.0	66.0	24.7	14.5	22.0	**5.79**
164	128	157	71.6	63.0	81.3	22.2	13.8	21.6	6.46
165	131	156	66.1	46.0	77.5	22.4	13.0	22.8	6.43
166	131	156	73.3	49.5	81.6	32.8	12.7	20.3	6.30
167	127	154	65.1	44.0	79.6	25.7	13.9	20.0	6.47
168	132	156	48.8	45.5	73.5	23.8	13.2	20.6	6.10
169	133	156	59.5	51.5	71.8	23.8	13.2	21.3	6.47
170	130	154	49.0	48.0	70.7	21.7	13.8	22.0	5.87
171	129	154	49.1	47.5	61.6	25.9	12.5	20.3	6.00
172	130	157	44.2	50.5	73.3	19.8	12.3	19.3	6.17
173	134	156	40.5	45.0	64.3	18.9	11.3	20.0	6.20
174	132	154	38.1	56.0	63.5	34.9	12.8	21.3	6.06
175	125	154	58.1	42.0	65.0	38.1	12.4	22.0	5.90
177	130	154	56.9	45.5	83.8	23.0	14.3	22.6	6.10
178	129	156	64.6	52.5	72.0	17.9	14.5	22.3	6.47
179	134	157	38.4	53.5	61.5	24.4	13.0	20.6	6.07
180	130	154	47.6	45.0	85.5	22.0	13.2	22.3	6.36
181	129	154	51.5	43.0	67.6	30.2	12.2	20.3	6.22
182	131	156	55.9	45.0	62.8	28.9	12.5	21.0	6.20
183	132	157	54.9	50.5	71.6	21.0	11.4	22.3	6.22
184	132	158	53.0	46.5	78.0	30.4	12.2	22.0	6.32
185	135	155	47.5	45.0	49.6	21.0	12.9	20.8	6.15
186	132	155	54.2	50.5	48.8	22.0	11.5	20.0	6.26
187	127	154	61.4	41.5	43.5	33.9	12.4	20.3	6.03
188	126	153	62.2	39.0	**41.5**	21.0	12.4	19.3	5.94
189	128	153	74.8	50.0	49.1	16.6	12.7	21.3	6.25
190	128	154	68.5	47.5	81.1	25.4	13.2	21.0	6.43
191	123	154	58.7	32.5	65.0	38.3	11.0	19.3	6.15
192	**140**	156	53.4	41.5	73.3	36.0	13.9	22.3	6.26
193	133	158	63.8	50.5	71.5	31.8	12.7	20.6	6.43
194	131	154	57.2	42.5	75.1	38.0	13.7	18.1	6.32
195	123	153	71.9	52.5	66.5	30.4	11.9	19.7	6.10
196	136	158	77.5	56.0	67.4	26.6	14.8	21.6	6.22
197	132	158	66.1	51.0	65.8	25.8	12.9	20.6	6.34
198	129	154	64.8	44.0	72.1	25.4	12.8	21.3	5.99
199	129	154	**80.4**	35.5	73.9	42.2	14.7	21.6	6.05
200	128	155	48.4	56.5	59.5	26.4	10.7	21.3	6.12
201	130	155	65.6	42.5	76.0	30.9	13.9	22.6	5.93
202	122	154	41.5	46.5	67.8	20.5	13.4	21.7	6.18
203	133	157	68.5	41.5	74.1	43.0	14.0	20.3	6.34
204	132	156	65.1	45.5	70.8	27.6	14.7	22.3	6.41
205	126	157	55.9	47.0	77.0	39.3	11.0	19.7	5.96
206	137	156	73.5	42.5	82.0	34.7	11.3	21.0	5.95
207	133	156	75.7	41.5	71.1	30.8	**19.3**	24.1	6.30
208	134	158	67.9	39.0	80.2	25.4	16.7	24.0	5.93
209	121	153	55.0	43.0	72.3	27.4	12.5	21.0	6.23
210	127	154	57.6	64.5	68.2	36.5	13.0	20.6	6.25
212	122	153	43.6	58.0	70.0	32.4	13.0	22.0	5.98
213	124	154	50.7	45.5	77.0	25.4	12.7	20.3	5.88
214	122	154	65.1	45.0	76.1	34.6	13.2	19.6	6.35
215	131	156	63.0	50.0	72.2	22.7	14.9	21.8	6.28
216	129	156	72.5	55.5	63.3	15.0	11.8	20.6	6.18
217	122	153	53.5	44.0	74.5	38.3	13.4	21.3	6.13
218	127	153	55.5	52.5	76.5	29.4	12.5	22.0	6.00
219	116	153	42.9	48.0	77.0	25.0	12.0	20.0	5.96
220	123	154	39.2	52.0	78.3	20.4	13.2	23.3	6.24

221	131	158	57.2	47.5	65.5	33.8	12.9	18.3	6.16
222	124	153	59.1	44.5	76.8	26.3	12.2	21.3	6.24
223	127	154	59.8	46.5	77.8	34.0	13.7	22.3	6.22
225	123	155	54.8	55.5	80.5	31.9	13.3	20.7	6.15
Means	**129**	**155**	**54.8**	**47.6**	**70.7**	**29.1**	**12.9**	**20.8**	**6.13**
LSD5%	**5.5**	**1.7**	**10.1**	**8.51**	**12.1**	**10.4**	**1.9**	**1.95**	**0.199**

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