International Scholars Journals

African Journal of Crop Science ISSN 2375-1231 Vol. 5 (2), pp. 001-005, February, 2017. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Estimate of genetic variability and correlation coefficients for some quantitative characters in bread wheat *(Triticum aestivum L.)*

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Accepted 24 November 2016

To improve wheat in terms of yield and other agronomic characters, twenty-five (25) varieties of bread wheat were selected to test the amount phenotypic and genotypic variability present and phenotypic correlation coefficients in relation to yield. High genetic coefficient of variation was obtained for weight of main spike and awn length. Heritability was found to be high for awn length, spike length, weight of the main spike and plant height. Total tillers per plant, spike length and number of grains per spike had moderate heritability with high genetic advance. Grain yield per plant was high and positively correlated with effective tiller per plant. A positive significant correlation of yield was observed with length of spike, spike lets per spike, weight of main spike and plant height. Effective number of tiller and weight of the main spike had high heritability with high genetic advance and significant positive correlation with yield.

Key Word: Estimate, genetic variability, correlation coefficients, quantitative characters, bread wheat, *(Triticum aestivum* L.).

INTRODUCTION

Wheat plant

Wheat (Tricticum spp.) is an annual plant that has spikelet inflorescence. A floret is composed of lemma, Palea and cryopsis or grain that has a deep furrow and a hairy tip or brush, the floret may be awned or awneless. Under normal high density production condition a wheat plant may produce 2-3 tillers whereas when well space on fertile soils, it may produce 30-100 tillers. The spike (head) of a plant may contain 14-17 spikelets and each spike containing about 25-30 grain. Large spike may contain between 50-70 grains. The grain size varies within the spikelet the largest being the second grain from the bottom and decreasing in size progressively toward the tip of the spike.

Wheat is predominantly a self pollinated. Another assumes a pendant position soon after the flower opens. Blooming occurs at a temperature between 13 – 25°C starting with the spikelet around the middle of the spike proceeding upwards and down wards. The wheat kernel or berry is a cryopsis of about 3-10 mm long and 3-5 mm wide. It is a multilayered pericarp that removed a long with the testa, nucellus and aleurone layer during milling. The endosperm makes up to 85% of well developed kernel below the aleurone layer occurs a complex protein called gluten that has comprehensive properties. It is responsible for the ability of wheat flour to hold together. Stretch and retain gas as fermented dough rises.

Wheat is classified based on three primary characteristics: Agronomic, kernel colour and endosperm quality. There are two seed coat colour, red and white. Red colour is conditioned by three dominant genes while the true whites comprise recessive alleles of the three genes. Kernel hardness is classified into two: hard and

soft. Upon milling hard wheat yields coarse flour while the white wheat lack this starch protein complex produce a higher yield of fine flour upon milling. Hard wheat is used for bread making because its gluten protein is cohensive and elastic.

Wheat is generally used for the production of confectionary products e.g Hard red winter and hard red spring wheat are standard wheat used for bread flour. While the soft red winter wheat are used mainly for pastry, cake, biscuit and household flour, for bread making it needs to be blended with hard red wheat flour. Durum wheat is used in making semolina, which is used for producing products such as macaroni, spaghetti and couscous and other local products.

Some of the quantitative characters which are of great importance for yield are usually influenced by environmental conditions, making it necessary to determined the magnitude and nature of genotypic and environmental variations present in these characters. They are important in helping breeders in selecting these characters for further improvement. This study is carried out to determine the genotypic and phenotypic variability present in twenty - five (25) bread wheat varieties and group the observed variabilities under heritable and non-heritable components on the base of genetic coefficient of variation, heritability and genetic advance. Simple correlation coefficients were also used to determine the relationship between different characters associated with grain. The objective of this study is to determine the genetic variabilities and agronomic characters associated with yield.

MATERIALS AND METHODS

Twenty five (25) bread wheat lines were planted in randomized block design with three (3) replications at a research station, Kerinowa, New Marte in 2006-2008 wheat seasons. Seed were drilled in plot size measuring $3 \times 5\ m^2$ consisting of 10 rows spaced at30cm apart. Fertilizer application was carried out as recommended and all other cultural and management practices for wheat production was observed. Ten (10) plants were randomly selected for recording observations on the fourteen (14) agronomic characters: - grain yield per plant, grain yield per spike, length of spike, number of spikelets per spike, number of tillers per plant, number of effective tillers per plant, plant height, number of leaves per plant, flag leaf area (cm^2), density of spike (per 5cm), length of awn, peduncle length, weight of main shoot, weight of main spike.

Flag leaf area was determined by the formula given by stickler et al. (1961) that is ¾ (leaf length + leaf bread that the broadest point).

The data was analysed in randomised block design and genetic constant for these fourteen (14) agronomic characters was calculated by using the component of variance from expected mean squares as described by Burton and DeVane 1953 in replicated clonal materials for tall fescus (Festucaarundinaceae (L.) and Gandhi et al (1964) for wheat (*Triticum aestivum* (L.) Estimate of phenotypic, genotypic and error variances thus obtained are presented in Table 2. Genotypic variance was obtained by subtracting mean square error from mean for varieties and dividing it by the number or replications.

$$GV = \frac{V - E}{N}$$ where GV = genetic variance, V = varietal mean s

E = error mean square and N = number of replication.

Where;
GV = genetic variance,
V = varietal mean square,
E = error mean square and
N = number of replication.

The mean square at error and varietal level were taken as error and phenotypic variance respectively. Genetic coefficients of variation were computed by dividing the square - root of genotypic variance by the population mean and multiplying by 100 (Burton 1952). Heritability was calculated by the formula suggested by Burton and DeVane 1953 and subsequently used Gandhi el al. 1964.

$$H = \frac{Vg}{Vg+VE}$$

Where
Vg = genotypic variance and
Vg +VE = phenotypic variance and
H = Heritability.

Expected genetic advance was calculated as suggested by Johnson et al. (1955) by formula;

$$GA = SVg/\sqrt{VP}$$

Where
GA = genotypic advance,
S = 2.06 for 5% population saved,
Vg = genotypic variance and
VP = phenotypic variance.

The formula suggested by Hay et al. (1953) was used in calculating phenotypic correlation coefficient.

RESULTS AND DISCUSSION

The F-values for treatment, range, means and SEm for different characters are shown in (Table 1). Statistical analysis showed that there is a significant difference between the characters studied (Table 2). Estimate of

Table 1. 'F' value for the treatments, range, means, and standard error of the means for yield contributing characters in bread wheat.

Characters	'F' value for treatments	Range	Mean	SEm
Grain yield per plant	1.62**	1.21-2.29	1.59	0.200
Grain per spike	3.96**	13.95-29.02	24.01	2.456
Length of spike	3.53**	4.87-9.89	7.01	0.650
Spikelets per spike	3.11**	11.49-14.90	14.42	1.005
Tillers per plant	2.82**	1.41-2.44	2.01	0.200
Effective tiller per plant	2.99**	1.12-1.85	1.55	0.180
Plant height	10.91**	47.05-76.98	62.32	3.001
Leaves per plant	2.70**	5.95-13.04	2.07	1.180
Flag leaf area	2.52**	6.92-12.98	10.02	1.496
Density of spike	2.55**	7.01-9.79	8.95	0.602
Length of awns	6.56**	7.09-16.25	10.60	0.620
Length of peduncle	6.08**	19.00-34.70	23.00	1.791
Weight main shoot	3.13**	1.25-3.21	2.67	0.199
Weight of main spike	6.52**	0.89-2.66	1.35	0.189

**significant at 0.001 level of probability.

Table 2. Phenotypic, genotypic, and error variance of the varietal means, genetic coefficient of variability, heritability, genetic advance expressed as the percent mean for yield contributing characters in bread wheat.

Characters	Phenotypic variance	Genotypic variance	Error variance	Genetic coefficient of variance	Heritability percent variance	Genetic advance	Genetic advance in percent of mean
Grain yield per plant	0.075	0.04	0.045	11.75	41.00	0.22	14.9
Grain per spike	15.612	11.05	3.550	14.98	76.62	5.41	23.0
Length of spike	0.990	0.71	0.272	12.13	72.71	1.46	22.0
Spikelet per spike	2.680	1.15	0.522	7.78	69.45	1.89	14.3
Tillers per plant	0.125	0.08	0.095	14.03	65.00	0.45	24.0
Effective tiller per plant	0.045	0.03	0.015	11.72	67.66	0.28	20.3
Plant height	51.977	47.40	4.570	10.91	92.03	13.39	22.9
Leaves per plant	2.340	1.52	0.820	14.15	65.95	1.00	11.5
Flag leaf area	3.090	1.81	1.275	13.20	59.87	2.12	21.8
Density of spike	0.610	0.36	0.250	7.07	60.01	0.94	11.0
Length of awns	14.007	13.80	0.200	34.95	99.04	7.14	61.0
Length of peduncle	11.032	9.40	1.732	13.50	84.74	5.39	23.2
Weight main shoot	0.125	0.08	0.040	11.76	64.00	0.45	18.8
Weight of main spike	0.112	0.09	0.020	20.13	80.35	0.55	36.9

phenotypic, genotypic and error variances indicate that phenotypic and genotypic variance was highest for plant height and low for effective tillers. Genetic coefficients of variation for different characters range from 7.07 to 34.95. The highest genetic coefficient of variation was observed in awn length followed by the weight of the main spike. It is however, difficult to determine the amount of heritable variation present in population using the genetic coefficient variance alone. The heritable variance can be obtained through heritable estimates and genetic gain, heritability values for all the characters indicated large variation (41.00 to 99.04), the highest was for the length of awn and lowest for grain yield per plant. Weible (1996); Sikka and Jain (1989) reported low heritable value for grain yield.

Johnson et al. (1955) reported that heritability value estimate along with genetic gain are more useful than heritability values alone in predicting the effect of selection. Genetic advance showed a high range of variation, 11.0 for density of spike and 61.0 for awn length expressed as percentage of mean (Table 2). The results indicate that individual plant selection for awn length, weight of main spike, length of peduncle and length of spike should be effective and satisfactory for

Table 3. Showing phenotypic correlation coefficients among of variability, heritability, genetic advance expressed as the percent mean for yield contributing characters in bread wheat.

Characters	Grain per spike	Length of spike	Spikelet per spike	Tillers per plant	Effective tiller per plant	Plant height	Leaves per plant	Flag leaf area	Density of spike	Length of awns	Length of peduncle	Weight main shoot	Weight of main spike
Grain yield per plant	-0.392*	0.460*	0.470*	-0.150	0.589**	0.438*	0.150	0.191	-0.388*	-0.240	-0.101	0.090	0.394*
Grain per spike		0.770**	0.823**	-0.258	-0.219	0.640**	-0.053	-0.242	-0.506**	-0.85**	-0.131	0.529**	0.480**
Length of spike			0.658**	-0.229	-0.175	0.740**	-0.095	-0.096	-0.886**	-0.772**	-.093	0.486*	0.500**
Spikelet per spike				-0.248	-0.132	0.580**	-0.012	-0.440**	-0.344	-0.778**	-0.329	0.477*	0.596*
Tillers per plant					0.78**	-0.079	0.599**	0.278	0.928	0.175	0.023	-0.123	-0.356*
Effective tiller per plant						0.001	0.560**	0.320	0.126	0.3811	0.016	-0.010	0.356*
Plant height							0.102	0.211	-0.543**	-0.698**	-0.264	0.454*	0.482
Leaves per plant								0.420*	0.033	0.598**	0.214	-0.281	-0.319
Flag leaf area									-0.093	0.240	0.327	-0.027	-0.131
Density of spike										0.588**	-0.163	-0.174	-0.140
Length of awns											0.168	-0.584*	-0.409*
Length of peduncle												0.310	0.085
Weight main shoot													0.686**

***, ****significant at 5 and 1% level of probability respectively.

practical selection purpose. Results about the grain yield per plant are not encouraging because it has low heritability and genetic advance.

The grain yield per plant was positive and significantly correlated with effective tiller per plant, length of spike, spikelets per spike, plant height and weight of the main shoot. Asana et al. (1999) and Sikka and Jain 1989 showed that grain yield was positive and highly correlated with effective tillers per plant in wheat. Sikka and Singh 1990 noted that grain yield was related with weight of main spike and tillering in wheat. Gandhi et al. (1979) observed positive correlation of effective tillers, length of year, and number of spikelets per spike with grain yield per year in irrigated wheat. Positive correlation was also observed between grain yield and plant height in wheat by Nandpuri (1995). Apart from grain yield, other significant correlations were observed between grain per spike and length of spike, spikelets per spike, plant height and weight of the main shoot. Length of spike gave highly significant correlation with spikelet per spike and plant height. Spikelet per spike gave significant correlation with plant height and weight of main spike. Tillers per plant showed significant correlation with effective tillers and leaves per plant. Numbers of effective tillers were correlated with leave with leaf per plant. Plant height was also correlated with density of spike and length of awns. Leaf per plant had positive and significant correlation with length of awn Table 3.

The component weight of spike and length of spike had high to moderate heritability with high genetic advance showed positive significant correlation with grain yield.

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