Diallel analysis of morphological traits in different wheat genotypes under drought stress conditions

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SYNOPSIS

Diallel analysis of morphological traits in different wheat genotypes under drought stress conditions.

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Certify that topic entitled "Diallel analysis of morphological traits in different wheat genotypes under drought stress conditions" has been decided and formulated by the student himself and is appropriate for his programme.

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OBJECTIVES OF THE INVESTIGATION:

1. To find out the genetic variability for various component characters.

2. To estimate the genetic components of variance.

3. To estimate the general and specific combining ability variances and effect in F_1

4. To estimate the Heterosis over mid parent and better parent in F_1.

5. To estimate the heritability and genetic advance for all the characters in both generations.

Introduction

Wheat (*Triticum aestivum* L.) is the first important and strategic cereal crop for the majority of world's populations. It is the most important staple food of about two billion people (36% of the world population). Worldwide, wheat provides nearly 55% of the carbohydrates and 20% of the food calories consumed globally. Wheat belongs to the tribe Triticeae of grass family Poaceae. It is a Hexaploid having 42 chromosomes (2n=6x=42). it is the leading source of vegetal protein in human food, having a protein content of about 13%, which is relatively high compared to other major cereals, but relatively low in protein quality for supplying essential amino acids. When eaten as the whole grain, wheat is a source of multiple nutrients and dietary fiber. The Bread wheat originated from Armenia in Transcaucasia to the south-west coastal areas of the Caspian Sea in Iran. The D-genome conferred on bread wheat and spelt wheat the adaptation to cold winters and humid summers thus allowing them to conquer temperate Europe and Asia. Wheat is having a protein gluten in content of about 13% which is relatively high compared to the other cereals. This protein can determine the suitability of wheat to a particular dish. The endosperm contains glucofructan which functions as prebiotic agent has similar properties to dietary fiber. Wheat is typically milled into flour which is then used to make wide range of foods including bread crumpets, muffins, noodles, pasta, biscuits, cereal bars, sauces and confectionary.

ECONOMIC IMPORTANCE:

According to FAO, the production of wheat is cultivated in the area of 215.26 million hectares with a production of 737 million metric tons. The normal world productivity is 2717 kg/ha. India stands in 2nd place in world production having an area of production around 31 million hectares with a production of 88.90 million tons with a productivity of 2872 kg/ha. The leading state in production of wheat in India is Uttar Pradesh having 52 lakh hectares under cultivation producing 300.10 lakh metric tons with productivity of 3100 kg/ha followed by Punjab with 35 lakh hectares area and 164.720 lakh metric tons in production, Haryana with 25 lakh hectares area and 116.30 lakh metric tons, Madhya Pradesh with 43 lakh hectares area and 76.271 lakh metric tons, Rajasthan with 25 lakh hectares area and 72.145 lakh metric tons. The statistical data of wheat in India is 304.3 lakh hectare area with 95.5 million tons of production and productivity of 3145 kg/ha (2013-14), 314.65 lakh hectares area with 86.52 million tons and productivity of 2750 kg/ha (2014-15), 312.27 lakh hectares area with 93.50 million tons and productivity of 3093 kg/ha (2015-16).Therefore, for attaining high yield potential level, the breeders need is to simplify this complex situation through handling of yields components. There is need to improve the quality of wheat grains and to develop high yielding potential varieties with high quality of seeds as well as high degree of resistance for different agro-climatic conditions. To achieve this goal, the genetic studies on the qualitative and quantitative parameters in wheat are needed to examine the nature of genetic variability for important quality attributes like protein content, tryptophan content, and seed hardness. In most of the biometrical approaches for genetic evaluation of the crop , the diallel cross analysis become a proved and important system to provide maximum information on genetic parameters related to breeding programme of some important metric traits within considerable short time .To judge the stability performance over a wide range of environments, diallel cross analysis simultaneously evaluates the potentialities of the variance and predict the desirable types for further breeding programme. Various models of genetic analysis of diallel crosses have been given by Jinks and Hayman 1953; Hayman 1954 a; 1954 b, Griffing, 1956 b; Gardner and Eberhart, 1966 and found suitable under limit facilities for achieving maximum genetic information .

JUSTIFICATION OF PROPOSED STUDY:

Considering the importance of wheat in agriculture economy, it is necessary to develop high yielding, good quality wheat variety and their adoption by the farmer's along with advanced technology due to concerted and coordinated effort in wheat research has made possible the development of advance wheat varieties. During (2012-13) the production of wheat fall by 2.42 mt as comparison to (2011-12) owing to the productivity decline by 58 kg/ha (1.84%) followed by marginal reduction in area by 0.22 m ha (0.73%) (**Directorate of Economics and Statistics, Government of India, New Delhi),** which is mainly due to lack of high yielding, disease and pest resistance and stable varieties besides some other reasons. Therefore, there is an urgent need to develop varieties having high yield as well as high quality with multiple resistance which may get fitted in intensive cropping system for boosting up its production. Inheritance pattern of yield and its components are pre-requisite for increasing the yield potential of any crop. The main objective of any breeding programme is the development of genotypes which may enhance the yield ability through the selection of potent parent and hybridization programme for better quality as well as quantity. New technologies, can be deployed which could have to achieve a quantum jump in development of good varieties along with productivity and production. Hence, the present investigation has been taken up to gather the information on components of variances and their effects, combining ability, Heterosis, heritability, and genetic advance for genetic analysis of yield and its contributing traits in wheat(*Triticum aestivum* L.). The genetic information related to yield and its components could be used efficiently for planning systematic breeding programme and hence for realizing improvement in yield. Thus the proposed study to develop new genotypes against abiotic stresses for different agro climatic conditions in wheat (*Triticum aestivum* L.) has been taken up to achieve the targets.

REVIEW AND LITERATURE

The recent development in biometrical genetics has played a considerable role in providing basic information and developing procedure for utilizing the germplasm to synthesize and to select new genotypes which will maximize the yield of food, feed and fiber (Gardner 1977).Fisher(1918) Wright(1935) and Haldane(1924)have made noteworthy contribution in this field .

The science of biometrical genetics gained momentum after the formulations of concepts of various parameters by Sprague and Tatum (1942), Comstock and Robinson (1948, 1952) and Mather and Jinks (1971, 1982); since there several mating designs and genetic models along with appropriate biometrical techniques for analysis and genetic interpretation have been developed. Among them, **generation mean analysis** (Mather,1949;Hayman and Mather ,1955; Hayman 1958; Jinks and Jones 1958; Mather and Jinks 1971,1982), **diallel analysis** (Jinks and Hayman 1953 ; Hayman 1954; Griffing ,1956; Eberhart ,1964; Gardner and Eberhart ,1966; Jensen, 1970); **partial diallel** (Kempthorne and Curnow, 1961; Fyfe and Gilbert ,1963; Bray, 1971); Triple test cross analysis (Kersey and Jinks 1968); two level diallel crosses (Hinkelmann 1974,1975);three way cross analysis (Rawling and Cockerham 1962);and partial three -way and four- way crosses **(Hinkelmann 1965,1968);**are mating design which provide easy way of generating a number of crosses in one or two generations and thus providing useful genetic information. Among the various mating design s which have been used mostly in different crops, the diallel cross is a simple and convenient way of collecting information on genetic components and their related parameters of breeding value for quantitative as well as quality and economic attributes in crop plants. A review and literature on these aspects is given below.

Mehta *et al.* (2000) observed that dominance and additive x additive interaction were involved in the inheritance of days of heading, spike length and spikelets per spike, while for biological yield, grain yield and harvest index, dominance, additive x additive, and dominance x dominance epistasis were also important.

Jedynaski (2001) recorded very high estimates of heritability for plant height, 1000-grain weight, medium for number of grain per ear and very low for number of tiller per plant, grain yield per plant.

Jedynski (2001) found positive correlation for number of tillers per plant and number of grain per spike with grain yield.

Kumar *et al*. (2002) reported that grain yield per plant had direct positive correlation with plant height, panicle length, number of effective tillers and 1000-seed weight

Salgotra (2002) studied Heterosis for grain yield in F_1 hybrids between 13 winter wheat and four diverse testers of spring wheat, two crosses viz., 6-110 x HPW 42 and IWWSN 6-134 x HS 240 showed significant economic Heterosis over standard variety HS 277.

Satyavant (2002) observed maximum heritability for ear length followed by number of grains per ear and peduncle length, whereas genetic advance was higher for plant height, peduncle length and ear length.

Pawar *et al*. (2003) examined heritability which ranged from 84.93 to 99.74 percent for plant height, number of productive tillers per plants, spike length, number of spikelets, grains per spike, 1000-grain weight and grain yield. Genetic advance and gain were highest for plant height and lowest for number of productive tillers per plant.

Dayal *et al*. (2003) studied combining ability for various traits in bread wheat under normal condition and salinity. The present investigation was therefore, conducted to genetic information on combining ability and the nature of gene action involved in the inheritance of grain yield and other component traits in wheat under salinity and normal conditions.

Singh *et al*. (2003) studied gene action and combining ability in wheat revealed that GCA and SCA variance were significant for plant height, number of productive tillers per plants, number of spikelets per spike, number of grain per spike, 1000 seed weight and per plant with preponderance of non-additive gene action and over dominance.

Yadav (2004) analyzed the combining ability from an 11 parent diallel cross of common wheat (*Triticum aestivum L*.) showed high significant GCA and SCA effect for grain yield, number of grain per spike 1000-grain weight, and protein content. The result signified the importance of both additive and non-additive gene effects in controlling the inheritance of traits studied .Preponderance of non-additive gene effect was observed for number of grain per spike. Cultivar K 9107 was best general combiner. Cross K 9391 x K9162 was the best combination which showed high SCA for grain yield, 1000-grain weight and number of grain per spike.

Gupta *et al.* (2004) reported high heritability for sedimentation value, protein content, and number of tiller per plant, phenol color reaction, and grain yield per plant. High genetic advance was observed for sedimentation value, number of spike per plant, number of tillers per plant and yield per plant.

Muhammad *et al.* (2004) studied moderate to very high broad sense heritability for all morphological characters except number of fertile tillers per plants.

Sahu *et al*. (2005) studied the heritability and genetic advance for the characters root number per plant, root weight per plant, chlorophyll concentration (SPAD value) grain yield per plant, number of spikes per plant and 1000-grain weight and reported high heritability coupled with low genetic advance for all the traits. Under such circumstances, selection would not be effective for improvement.

Punia *et al*. (2005) estimate the Heterosis of the yield and neat tolerant traits these single cross hybrids along with their parent were shown in three different dates.
Dassasi (2005) studied the combining ability for different quantitative traits like, plant height, days to 50% flowering, number of tillers per plant, spike length, number of grain per spike, total biomass, grain yield per plant, harvest index and 1000-grain weight in bread wheat and reported that variance due to females, males and females x males were significant for all the traits. The GCA and SCA variance ratio revealed the pre-penetrance of non-additive gene action in governing the expression of all the characters except plant height and peduncle length.

Rathi *et al*. (2006) observed that the general combining ability was dominant to the specific combining ability for all traits, the non- additive component was generally superior to the additive component.

Inamullah *et al.* (2006) observed that additive component was significant for all traits except spike length, tillers per plant, and yield per plant.

Joshi and Sharma (2006) found that GCA and SCA components of variances were significant for all traits. However, the GCA component of variance was predominant, indication the preponderance of additive gene effects for traits studied.

Sangeeta *et al*. (2006) found that the dominance components were superior to the additive component for 8 traits. The GCA was dominant to SCA and non-additive component was superior to additive component.

Joshi and Sharma (2006) found that GCA and SCA components of variances were significant for all traits. However, the GCA component of variance was predominant, indicating the prevalence of additive gene effects for traits studied.

Prashad *et al*. (2006) observed that high heritability along with genetic advance for days of heading, days of anthesis, plant height, flag leaf area, and number of grain per spike.

Mohammad *et al*. (2006) found that narrow sense heritability estimates for coleoptiles length, plant height, spike length, and 1000-grain weight 94, 94, 42 and 64 percent, respectively.

Butto *et al*. (2006) recorded that grain yield per plant had positive correlation with spike length (r =0.39), number of grains per spike (r=0.823), number of tillers per plant(r=0.789), seed index(r=0.769), and days of maturity(r=0.564).

Akhtar *et al. (*2006) the estimated genotypic correlation coefficient was higher than the phenotypic correlation coefficient for both crosses and their reciprocals.

Sharma *et al*. (2006) observed that grain yield was positively and significantly correlated with tiller per plant, biological yield, grains per ear, days of maturity, and ear length. The path analysis suggested that total biomass and number of tillers per plant were the main contributors toward grain yield per plant.

E1.Marakby *et al*. (2007) found significant positive correlation between grain yield per plant and each of days to heading and maturity, flag leaf area, number of spikelets per spike and number of grain per spike under all environments.

Path analysis illustrated that number of grains per spike under all environment followed by flag leaf area under the two N-level at late sowing date and number of spikelets per spike under high N-level sowing date proved to be the major contributors in grain yield variation.

Muhammad *et al*. (2007) observed the grain yield per plant had positive and significant correlation with flag leaf area, tillers per plant, spike length, grain per spike, grain weight per spike, and 1000-grain weight.

Menon *et al.* (2007) revealed that highest heritability with more genetic advance for plant height, number of spikelets per spike and number of grain per spike and some crosses were showed more number of tillers per plant, spike length and grains per spike with more heritability and genetic gain.

Ahmad *et al*. (2007) observed that narrow sense heritability estimates were 69.74 and 82.15 percent for flag leaf area and plant height respectively suggesting improvement through early generation selection while narrow sense heritability estimates for spike length, grain yield per plant, and harvest index favored selection at later stage.

Singh *et al*. (2007) observed heterotic response over economic parent based on combining ability for yield and quality traits is eleven parents.

Tahmasebi et *al*. (2007) observed that there was highly significant GCA and SCA mean squares, indicated more importance additive genetic effects on controlling. Plant height, spike length, number of grain per spike and number of spikelets per spike for these inheritance were partial dominance, while over dominance gene action were observed for other traits.

Ahmad *et al*. (2007) revealed that significant additive and dominance gene action for plant height, spike length, and grain yield under normal planting. Under late planting, significant additive and dominance variance were found.

Singh *et al*. (2008) reported that grain yield Heterosis was due to Heterosis manifested by number of grains/spike, length of spike and test weight. The cross K9533 x K9423 was found top hybrid having high economic Heterosis. Two crosses exhibited low inbreeding depression indicating additive x additive type of gene action.

Shiv Kumar *et al*. (2008) found that the number of tillers per plant, number of spikelets per spike, number of grain per spike, 1000-grain weight, and biological yield could form strong selection indices for selection of high of yielding genotypes.

Dagustu N. (2009) Reported that the highest account of heritability was observed for plant height followed by grains per spike, days of 75% flowering, 1000-grain weight and grain yield per plant and reported that the genetic advance as percent over mean was high for number of tillers per plants, height and gracious yield per plant.

Singh *et al*. (2009) studied Heterosis over mid-parent value in 28 F_1 s for grain yield and seven under related characters. The cross combination HVW468 x UP2425 was found top hybrid having high Heterosis for grain yield per plant.

Bao-Yin Guang *et al*. (2009) reported that Heterosis estimates for spike length, flag leaf area, number of spike per plant, number of spikelets per spike, 1000-kernel weight and grain yield per plant were exhibited in all the crosses by SN 0095, but heterobeltiosis occurred only for KPS, TKW and GYP. The relative mid-parent Heterosis (RMH) and relative better parent Heterosis (RBH) were as high as 35.32 and 29.92% respectively, as well as highest values among all the traits measured.

Zhao-Peny et al.(2009) reported that combining ability estimates for spike length, grain number per spike, grain weight per spike and 1000- seed weight were mainly due to additive genes effect. Some parents had high value of general combining ability (GCA) for certain specific crosses.

Zhao-Peng *et al*. (2009) found high Heterosis over mid-parent for length of spike and plant height in all the crosses with desirable heterotic effects. The range of Heterosis over the control for grain weight per spike and 1000-seed weight was significantly different among the crosses, and most of the hybrids (90% of grin weight per spike and 70% for 1000-seeds weight) had positive Heterosis. One best cross, (3218 x fen 2), which had significant Heterosis (16.7%) for yield per plant over the control was identified.

Khosla *et al*. (2010) reported that the grain yield, biological yield and grain per spike had high values of GCV along with heritability and genetic advance.

Khosla *et al. (*2010) reported that positive and significant correlation between seed yield per plant, plant height, spikelets per spike, spike per plant, grain per spike, biological yield and harvest index and spike per plant had significant positive direct effect on grain yield.

Muhammad *et al.* (2011) reported that grain yield had positive and significant correlation with spike length, number of spikelets, 1000-grain weight, and grain yield kg/ha.

Ashutosh *et al.* (2011) Observed heritability and genetic advance in 7x7 diallel cross analysis in bread wheat. The highest account of heritability was observed for plant height, followed by number of grain per spike, days of 75% flowering, 1000-grain weight, and grain yield per plant.

Yucel *et al*. (2011) reported that the variances for combining ability showed that both additive and non-additive gene action were involved in controlling most of the traits. Magnitude of GCA for all features except grain weight and plant height was higher than those of SCA. Parents in hybridization for getting desirable segregant in segregating generation.

Burungale *et al*. (2011) reported that the combining ability for important quality characters in an 8 parents diallel crosses. Both the additive and non-additive gene action played an important role for the inheritance of the characters. The ratio of GCA and SCA genetic variances for all the characters indicate that non-additive type gene action was predominant in the expressing of all traits that is plant height, number of production tillers length of mean spike, spikelets per spike, number of grain per spike, 1000-seed weight and grain yield per plant.

Methods and Materials

The material for the present study has been taken from National Bureau of Plant Genetic Resources (NBPGR); New Delhi .The basic material will comprise the following accessions viz; IC78751, IC532116, IC66520, IC78749, IC138866, IC78801, IC55681, IC78737, IC532889 and IC66539.

(I)Production of F_1s:

All possible single crosses will be made during the year 2017-18 to complete a 10X10 half diallel set without reciprocal due to absence of extra nuclear inheritance in wheat (Whitehouse, at al.1958)

The following observation will be recorded from the above experiment in F_1 and F_2 populations along with their parents.

Observation to be recorded:

1-Days of 75% flowering

2-Plant Height

3-Number of tiller per plant

4- Number of Spikelets per spike

5- Spike length per plant

6- Number of grains per spike

7-Days of maturity

8- 1000 -Grain weight (g)

9-Ear density

10-Duration of reproductive phase

ANALYSIS OF DATA:

The data collected on the above proposed characters will be subjected to the following statistical/ biometrical analysis.

(i) Analysis of variance (ANOVA)

(ii) Diallel analysis

(a)Genetic component analysis

(b)Combining ability analysis

(iii) Estimation of Heterosis and inbreeding depression

(vi) Estimation of selection parameters

(a) Heritability in narrow sense

(b) Genetic advance

(c) Correlation coefficients

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