Genetic Analysis of Eight Crosses for Quantitative and Qualitative Trait in Wheat (*triticum aestivum l.*) over the Environments

Sonali A Aware*, N.R.Potdukhe

*Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola*

**Abstract** — The objective of the study was to estimate gene effects for quantities and qualitative traits viz., Plant height, no of tillers per plant, no of spiklets per spike, no of grains per spike, grain weight per ear head, grain yield per plant (g), Days to heading, Protein content (%), Sedimentation value (ml), Beta carotene content (ppm) and 1000 seed wt. (g) using six generations of eight crosses was carried out during rabi season at two locations. Analysis of Variance revealed highly significant differences among the wheat genotypes for all the characters. In case of plot basis observations, the characters were mostly governed by dominance gene effects.

**Keywords** — Wheat; Six Parameter Models; Gene Effects

1. **Introduction**

Wheat is an important winter cereal crop contributing about 32 per cent of total food grain production in India (Singh et al., 2004). It is staple food crop in at least 43 countries.

Wheat is an annual plant belongs to tribe *Triticaceae*, sub family *Pooideae* of family *Poaceae*. Wheat is having 7 pair of chromosomes (2n=14). Bread wheat, due to its versatile nature is widely cultivated under different agro-climatic conditions. In India, wheat is considered as the second most significant food crop after rice. Wheat grown on 29.50 m ha with annual production of 93.60 m tonnes with an average productivity of 31.25 q/ha.

The choice of selection and breeding procedure for genetic improvement of any crop is largely depend upon the knowledge of the type and relative amount of genetic component. Information the type of gene action involved in the inheritance of characters is helpful in deciding procedure to be followed for improvement. Plant breeders frequently use generation to mean the analysis to obtain information on gene action controlling the economic traits in wheat. Therefore, the present study was carried out to obtain information about gene action on yield and it’s components in the eight crosses. The main objective of Wheat breeding is to increase grain yield however, yield is a quantitative traits and is affected by many genetic and non-genetic factors. To increase yield, it is necessary to improve agronomic traits which affects grain yield, but in order to achieve this, more information on the inheritance pattern of these traits is necessary.

More significance of dominance gene effects are determined than additive gene effects for grain yield and its component traits. Also, additive x additive type of epistatic interaction was found to be significant for a number of tillers per plant. Pedigree method and simple selection were suggested for improvement of traits governed by additive, additive x additive gene effects in some crosses. Identification of optimum selection periods for these traits was aimed.

2. **Materials and Methods**

Six generations of eight crosses were planted during Rabi season 2011-12 carried out at two locations viz., Wheat Research Unit, (Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, M.S) and Agriculture Research Station, Niphad (Mahatma Phule Krishi Vidyapeeth, Rahuri M.S) in Randomized Block Design with three replications. The data were first subjected to test the differences between parental genotypes by applied “t” test for Joint scaling test as indicated by was applied to test the adequacy of the genetic model controlling the studied characters. The genetic model (m, d & h) was applied when epitasis was absent, whereas, the presence of non-allelic interaction the analysis was proceeded to estimate the interaction types involved using the Six generations model i.e., (m, d, h, i, j & l).

3. **Result and Discussion**

The mean values and their standard errors for analyzed traits are presented in Table -1 (a & b) in the Pooled environmental condition. The mean values were highly significant for various characters. The scaling test for the Pooled environmental condition were presented in Table -2 (a & b) The estimates of generation mean components in eight crosses on plot and plant basis characters over the Pooled environmental condition were presented in Table -3 (a & b)

**3.1 The results and discussion related to plot basis observations were as followed**
3.1.1 Days to Heading

Scaling tests were found to be non-significant for all cross, thereby indicating that the absence of non-allelic interaction in the expression of days to heading character. Data on components of generation mean revealed that significant dominant gene effects for days to heading in Cross-HI-1418 x LOK-54 only, while rest of crosses showed only mean significant. Muhammad Aslam Chowdhary (2006) indicated that additive, dominance and epistatic genetic effects seemed to have played role in the inheritance of this character Ahmad et al. (2007) dominant x dominant (l) epistasis were more important than additive x additive (i) epistasis. The degree of dominance in most of the traits indicated the predominance of dominant gene effects.

3.1.2 1000 Seed Weight (g)

Significance of scaling test for 1000 seed weight in Cross-VI, AKAW-2978-12 x PHS-0722 indicated the inadequacy of additive-dominance model and character in those crosses was under the control of epistatic type of interactions. While rest of the crosses showed non-significance of scaling test indicated the adequacy of additive-dominance model. The dominance x dominance (l) was significant only in Cross-VI (AKAW-2978-12 x PHS-0722). The nature of epistasis is duplicate type. The epistasis was found insignificant for the rest of crosses. The dominance (h) gene effect is significant for Cross-IV (AKAW-3997 x NIAW-35) and Cross-VI (AKAW-2978-12 x PHS-0722). However, both additive (d) and dominance (h) component were found significant in Cross-III (HI-1418 x LOK-54), Cross-V (DL-788-2 x AKAW-3722) and Cross-VIII (GW-496 x AKAW-4651). Naeem Akhtar and Muhammad Aslam Chowdhary (2006) indicated that additive, dominance and epistatic genetic effects seemed to have played role in the inheritance of this character.

3.1.3 Protein content (%)

For protein content in Cross-III (HI-1418 x LOK-54) and Cross-V (DL-788-2 x AKAW-3722) result revealed that, the epistasis was found insignificant in both crosses, additive (d) is significant for Cross-III (HI-1418 x LOK-54) while dominance (h) is significant for cross-V (DL-788-2 x AKAW-3722).The interaction dominance x dominance (l) was larger than i and j interactions, while, among main effects, the dominance component (h) is greater than additive component (d). The nature of epistasis is duplicate type except for Cross-I (AKW-619 x DBW-31). The nature of epistasis is complementary type. Rahman et al. (2003) observed the partial dominance of the character of protein content. Kapoor and Luthra (1992) studied nature of gene effects governing inheritance of quality traits and reported that presence of non-additive gene effects for all quality traits viz. protein content, gluten content, sedimentation value, tryptophan content, methionine and lysine content. They suggested that selection within a single segregating population would be powerless to utilize such a variation. Therefore crosses between genetically diverse parents should be attempted and selection should be followed for few generations. Duplicate type of epistasis was indicted by all the quality traits. They indicated the nature and magnitude of gene effects may vary for same quality character with different crosses.

Zahid Akram et. al. (2007) reported additive genetic effects with partial dominance and suggested that selection could be practical in early segregating generations for improvement in these traits.

3.1.4 Sedimentation Value (ml)

Cross-V (DL-788-2 x AKAW-3722), Cross-VI (AKAW--2978-12 x PHS-0722) and Cross-VIII (GW-496 x AKAW-4651) in which the epistasis was found insignificant. In Cross-V (DL-788-2 x AKAW-3722) and Cross-VIII (GW-496 x AKAW-4651), the additive (d) and dominance (h) both component were significant while in case of Cross-VI (AKAW-2978-12 x PHS-0722), the additive (d) component was found significant. In case of Cross-I, AKW-619 x DBW-31 Cross-II, AKAW-3997 x AKAW-3722, Cross-IV, AKAW-3997 x NIAW-34 and Cross-III, HI-1418 x LOK-54 reported the presence of additive dominance type of non-allelic interaction in the expression of sedimentation value. While, scale B and D were found significant in Cross-II, AKAW-3997 x AKAW-3722 and Cross VII, GW-496 x NIAW-301 which indicated the presence of additive x dominance and additive x additive type of non-allelic interaction for sedimentation value. Among the interactions, the dominance x dominance interaction (l) was larger than i and j both component. Hence, the dominance (h) was greater than the additive (d) component. The nature of epistasis is duplicate type. Kapoor and Luthra (1992) reported that presence of non additive gene effects for the trait like sedimentation value. Bebyakin and Korobova (1989), Bebyakin and Starichkova, (1992) reported the additive and non additive gene effects predominantly control the sedimentation value. Dhaliwal et al. (1994) reported parent cultivars differed by partially dominant gene for low SDS sedimentation value.

Dhillon et. al. (2003) studied on six generations of four wheat crosses for grain yield per plant, grains per spike, 1000-grain weight, Protein content (%), β-carotene, semolina recovery (%), yellow berry (%) and sedimentation values. They observed that grain yield per plant showed moderate to high positive association with β-
carotene, but significant negative association with protein content indicated difficulty in simultaneous improvement in these traits. Grain per spike exhibited high magnitude of positive association with yellow berry, semolina recovery, \( \beta \) - carotene and sedimentation value, but negative with protein content. 1000-grain weight exhibited significant magnitude of negative correlation with yellow berry, \( \beta \) - carotene and protein content, but positive association with sedimentation value in all the crosses. For a more efficient approach towards improvement of grain quality along with yield and selection should be exercised based on quality component. Therefore study suggests that selection in durum wheat should be based on protein content sedimentation value and \( \beta \) - carotene along with yield per plant.

### 3.1.5 \( \beta \)-carotene Content (ppm)

Scaling test were found to be non-significant in Cross-III, HI-1418 x LOK-54, Cross-V, DL-788-2 x AKAW-3722, Cross-VI, AKAW-2978-12 x PHS-0722 and Cross-VIII, GW-496 x AKAW-4651, thereby indicating the absence of non-allelic interaction in the expression of \( \beta \)-carotene content. There is presence of dominance x dominance type of non-allelic interaction in Cross-II, AKAW-3997 x AKAW-3722.

Data presented on components of generation mean are, the interactions the dominance x dominance interactions was larger than I and j component. Except in Cross-II (AKAW-3997 x AKAW-3722), the additive x additive component (i) was larger than j and l component. The h and l were opposite direction, the nature of epistasis is duplicate type.

According to Meenakshi et al. (2005) \( \beta \)-carotene content is higher when a variety is grown in rainfed condition and it decreases when grown under irrigated condition and this is true in case of most of the varieties.

Zahid Akram et al. (2007) studied on eight wheat varieties selected on the basis of phenotypic diversity, to investigate the nature of gene action determining the inheritance pattern of protein, lysine, gluten and flour yield. In order to ascertain the gene action concerned in the inheritance of characters, the techniques such as analysis of variance of Hayman model and genetic component analysis were employed. Protein contents and flour yield being controlled by additive genetic effects with partial dominance suggested that selection could be practical in early segregating generations for improvement in these traits. Verma et al. (2009) reported by relative association between \( \beta \)-carotene and test weight in durum wheat.

### 3.2 The results and discussion related to plot basis observations were as followed

#### 3.2.1 Plant Height (cm)

All scaling test were found to be significant in Cross-III, HI-1418 x LOK-54 and Cross-VII, GW-496 x NIAW-301 which indicate the presence of non-allelic interaction in the expression of plant height. Scale A, C and D were found significant in Cross-I, AKW-619 x DBW-31, which indicated the presence of non-allelic interaction, Scale A and D were found significant in Cross-II, AKAW-3997 x AKAW-3722, which indicated the presence of additive x dominance and dominance x dominance type of non-allelic interaction in the expression of plant height. In case of Cross-IV, AKAW-3997 x NIAW-34, Scale C and D were found significant which indicated the presence of dominance x dominance and additive x additive type of non-allelic interaction. Scale B, C and D were found significant in Cross-V, DL-788-2 x AKAW-3722, for plant height. While, Scale A, B and D were found significant in Cross-VI, AKAW-2978-12 x PHS-0722. However, Scale A, B and C were found significant in Cross-VIII, GW-496 x AKAW-4651 in the expression of plant height.

The interaction components put together use larger than the combined main effects. Among the interactions, the dominance x dominance (l) was larger than I and j interaction effects, while among main effects, dominance (h) is greater than the additive component. The h and l are in opposite direction for four crosses Cross-II (AKAW-3997 x AKAW-3722), Cross-III (HI-1418 x Lok-54), Cross-VII (GW-496 x NIAW-301) and Cross-VIII (GW-496 x AKAW-4651), Hence, the nature of interaction is duplicate type, while h and l are in same direction for four crosses, Cross-I (AKW-619 x DBW-31), Cross-IV (AKAW-3997 x NIAW-34), Cross-V (DL-788-2 x AKAW-3722) and Cross-VI (AKAW-2978-12 x PHS-0722), hence the nature of interaction is complementary type.

Ahmad et al. (2007) are opined that dominant effect was the most contributor factor to inheritance of majority of traits in spring wheat, while Rahman et al. (2003) reported importance of partial dominance for plant height character.

The epistasis is insignificant for the Cross-VIII GW-496 x AKAW-4651. The dominance (h) is greater and significant than the additive component (d) for plant height trait. Muhammad Saleem (2005) also reported similar findings for the character plant height.
3.2.2 Number of Tillers per Plant

The dominance x dominance (I) was larger than I and j interaction effect. Except for Cross-IV (AKAW-3997 x NIAW-34), the additive x additive (i) was larger than j and l interaction effect. The nature interaction is duplicate type Cross-I (AKW-619 x DBW-31) and Cross-VII GW-496 x NIAW-301) while the rest of crosses the nature of interaction is complimentary type. The epistasis is insignificant for Cross-II (AKAW-3997 x AKAW-3722) and Cross-VIII (GW-496 x AKAW-4651) the dominance (h) is greater and significant than additive (d) component for number of tillers per plant. Neem Akhatar and Chowdhry (2006) showed (i), (j) and (l) type of epistatic effects together which indicated complex inheritance for this trait. Ojaghi and Akhundova (2010) reported duplicate epistasis for number of tillers per plant.

3.2.3 Number of Spikelets per Spike

For number of spikelets per spike, the interaction dominance x dominance (I) was larger than i and j interaction effects, while among interactions dominance x dominance (l) was larger than I and j interactions, while among main effects, dominance (h) is greater than the additive (d) component. The nature of epistasis is duplicate type for number of spikelets per spike except for Cross-IV, AKAW-3997 x NIAW-34 in which the nature of epistasis is complementary type. Ojaghi and Akhundova (2010) reported duplicate epistasis for number of spikletes per spike.

3.2.4 Number of Grains per Spike

The result observed that the interaction dominance x dominance (I) was larger than I and j interaction effects except in Cross-V (DL-788-2 x AKAW-3722), hence the additive x additive component (i) was larger and significant than j and l interaction effects. The nature of epistatis for all crosses under study for number of grains per earhead is duplicate type. Neem Akhatar and Chowdhary (2006) showed dominance and dominance x dominance type of epistasis for number of grains per spike trait.

3.2.5 Grain Weight per Earhead (g)

The interactions dominance x dominance interaction (l) was larger than I and j interaction except in Cross-I (AKW-619 x DBW-31) and Cross-IV (AKAW-3997 x NIAW-34). The dominance x dominance interaction (l) was larger than I and j interaction. The nature of epistasis is duplicate type except for Cross-IV (AKAW-3997 x NIAW-34) and Cross-V (DL-788-2 x AKAW-3722) the nature of epistasis is complimentary type.

Fatchi et al. (2004) observed higher value of additive gene effect comparing with dominant gene effect for this trait. Chowdhry et al. (2001) noted yield per plant was governed by over dominance type of gene action. Inamullah et al. (2006) noted significance of dominant component for this trait. Naeem Akhtar and Muhammad Aslam Chawdhary, (2006). Ahmad et al. (2007); showed presence of epistasis additive x dominance, dominance x dominance was important implication of breeding programme for stander hybridization and selection procedure. and useful for developing hybrid and also reported that epistasis was important for the expression of grain weight per ear and selection in later segregating generations would be more effective for improvement. Muhammad Munir et al. (2009) reported that grain weight per spike controlled by additive genes.

3.2.6 Grain yield per Plant (g)

For grain yield per plant result observed that the epistasis is found insignificant for Cross-V (DL-788-2 x AKAW-3722) and Cross-VIII (GW-496 x AKAW-4651) in both crosses dominance (h) is greater and significant than the additive component (d). The dominance x dominance interaction (l) was larger than I and j interaction. Among the main effects, dominance (h) is greater than additive component (d). The nature of epistasis is duplicate type. Fatchi et al. (2004) observed higher value of additive gene effect comparing with dominant gene effect for this trait. Chowdhry et al. (2001) noted yield per plant was governed by over dominance type of gene action. Inamullah et al. (2006) noted significance of dominant component for this trait. Shekhawat et al.(2001) reported the dominance, dominance x dominance type o gene effect with higher magnitude and duplicate type of epistasis. Chowdhry et al. (2001) noted yield per plant was governed by over dominance type of gene action. Fatchi et al. (2004) also observed higher value of additive gene effect as compared with dominant gene effect for this trait. Inamullah et al. (2006) noted significance of dominant component for this trait. Ojaghi and Akhundova (2010) reported duplicate epistasis for number of tillers per plant.
Table 1(a): Mean performance of five characters recorded on plot basis in Pool environmental conditions

| Crosses                        | Days to heading | 1000 Seed weight (g) | Protein content (%) | Sedimentation value (ml) | Beta carotene (ppm) |
|-------------------------------|-----------------|----------------------|---------------------|--------------------------|---------------------|
| Pool Environment Cross - I (AKW-619 x DBW-31) |                 |                      |                     |                          |                     |
| P1                            | 54.33 ± 2.29    | 42.45 ± 0.50         | 12.73 ± 0.24        | 29.33 ± 0.42             | 3.39 ± 0.18         |
| P2                            | 55.50 ± 2.76    | 43.48 ± 0.56         | 11.88 ± 0.22        | 30.33 ± 0.61             | 2.76 ± 0.23         |
| F1                            | 52.00 ± 1.80    | 41.64 ± 1.74         | 14.13** ± 0.43      | 36.50** ± 1.25           | 4.79 ± 0.28         |
| F2                            | 51.66 ± 1.56    | 41.68 ± 1.74         | 12.65 ± 0.38        | 32.33 ± 1.20             | 4.62 ± 0.23         |
| BC1                           | 54.33 ± 1.66    | 42.87 ± 0.57         | 12.21 ± 0.12        | 31.00 ± 0.44             | 4.08 ± 0.37         |
| BC2                           | 53.72 ± 2.07    | 42.80 ± 1.06         | 12.18 ± 0.29        | 29.33 ± 0.66             | 3.21 ± 0.25         |
| Pool Environment Cross - II (AKAW-3997 x AKAW-3722) |                 |                      |                     |                          |                     |
| P1                            | 57.00 ± 2.42    | 46.04 ± 3.93         | 11.35 ± 0.26        | 36.33 ± 1.76             | 3.75 ± 0.32         |
| P2                            | 57.83* ± 2.77   | 45.60 ± 1.81         | 11.69 ± 0.28        | 30.33 ± 0.61             | 3.30 ± 0.27         |
| F1                            | 54.16 ± 2.05    | 47.01 ± 3.91         | 13.99** ± 0.23      | 30.00 ± 1.26             | 4.90 ± 0.16         |
| F2                            | 54.33 ± 2.10    | 48.24 ± 3.20         | 13.57** ± 0.32      | 28.16 ± 1.04             | 5.06 ± 0.27         |
| BC1                           | 56.16 ± 2.85    | 46.91* ± 2.81        | 12.01 ± 0.22        | 27.66 ± 0.61             | 4.60 ± 0.28         |
| BC2                           | 56.00 ± 3.44    | 47.10 ± 1.00         | 12.68 ± 0.31        | 28.00 ± 0.51             | 4.63 ± 0.82         |
| Pool Environment Cross - III (HI-1418 x LOK-54) |                 |                      |                     |                          |                     |
| P1                            | 54.50 ± 2.48    | 40.80 ± 0.59         | 11.17 ± 0.25        | 31.66 ± 0.61             | 4.13 ± 0.26         |
| P2                            | 55.66 ± 2.40    | 44.52 ± 1.56         | 11.99 ± 0.03        | 31.33 ± 0.66             | 4.01 ± 0.33         |
| F1                            | 51.00 ± 0.89    | 51.12** ± 3.45       | 12.08 ± 0.33        | 32.50 ± 1.45             | 5.88** ± 0.17       |
| F2                            | 53.16 ± 1.90    | 48.52 ± 0.95         | 11.64 ± 0.37        | 30.66 ± 0.84             | 5.57* ± 0.26        |
| BC1                           | 52.83 ± 0.54    | 49.60* ± 1.32        | 12.11 ± 0.12        | 30.16 ± 0.40             | 4.88 ± 0.34         |
| BC2                           | 54.00 ± 0.85    | 50.01* ± 0.75        | 11.79 ± 0.27        | 30.00 ± 0.44             | 4.20 ± 0.19         |
| Pool Environment Cross - IV (AKAW-3997 x NIAW-34) |                 |                      |                     |                          |                     |
| P1                            | 57.33 ± 2.30    | 37.50 ± 0.23         | 11.63 ± 0.18        | 38.33** ± 1.74           | 4.07 ± 0.31         |
| P2                            | 59.16** ± 1.42  | 37.10 ± 1.50         | 11.54 ± 0.36        | 38.66** ± 0.98           | 3.89 ± 0.38         |
| F1                            | 55.16 ± 2.35    | 45.16 ± 1.72         | 13.51** ± 0.11      | 40.00** ± 0.51           | 4.93 ± 0.10         |
| F2                            | 55.50 ± 2.63    | 42.79 ± 1.70         | 12.89 ± 0.22        | 37.50** ± 0.88           | 5.63* ± 0.40        |
| BC1                           | 57.00 ± 2.12    | 41.48 ± 1.86         | 12.04 ± 0.31        | 36.00 ± 0.89             | 4.56 ± 0.56         |
| BC2                           | 57.00 ± 1.86    | 39.55 ± 0.82         | 12.11 ± 0.13        | 34.66 ± 0.98             | 3.94 ± 0.17         |
| Pool Environment Cross - V (DL-788-2 x AKAW-3722) |                 |                      |                     |                          |                     |
| P1                            | 54.50 ± 1.92    | 39.62 ± 0.90         | 11.65 ± 0.17        | 29.66 ± 0.33             | 4.26 ± 0.20         |
| P2                            | 53.66 ± 1.96    | 44.06 ± 0.97         | 11.80 ± 0.13        | 35.00 ± 1.78             | 4.62 ± 0.46         |
| F1                            | 51.50 ± 0.56    | 50.48** ± 2.08       | 12.55 ± 0.38        | 35.16 ± 0.60             | 5.53* ± 0.14        |
| F2                            | 51.00 ± 1.77    | 48.11 ± 1.98         | 12.18 ± 0.21        | 32.83 ± 0.70             | 5.39 ± 0.30         |
| BC1                           | 52.50 ± 0.56    | 46.25 ± 1.38         | 11.87 ± 0.22        | 33.66 ± 1.40             | 5.00 ± 0.45         |
| BC2                           | 51.33 ± 2.29    | 48.01 ± 3.07         | 12.15 ± 0.13        | 33.83 ± 1.47             | 4.66 ± 0.24         |
| Crosses                                      | Characters | Days to heading | 1000 Seed weight (g) | Protein content (%) | Sedimentation value (ml) | Beta carotene (ppm) |
|---------------------------------------------|------------|----------------|----------------------|---------------------|--------------------------|---------------------|
| Pool Environment Cross -VI (AKAW-2978-12 x PHS-0722) |            | P1             | 58.00* ± 1.86        | 38.78 ± 0.92        | 12.92 ± 0.17             | 40.16** ± 0.83     |
|                                             |            | P2             | 56.50 ± 2.10         | 39.13 ± 0.81        | 12.70 ± 0.16             | 30.33 ± 0.95     |
|                                             |            | F1             | 54.66 ± 1.52         | 45.81 ± 1.57        | 14.15** ± 0.26           | 38.00** ± 1.29 |
|                                             |            | F2             | 54.83 ± 1.32         | 44.30 ± 1.75        | 13.81** ± 0.25           | 35.50 ± 1.58    |
|                                             |            | BC1            | 58.00* ± 1.78        | 38.98 ± 0.79        | 14.30** ± 0.23           | 37.83** ± 0.40  |
|                                             |            | BC2            | 57.83* ± 1.77        | 41.63 ± 1.10        | 13.54** ± 0.26           | 34.83 ± 1.16    |
| Pool Environment Cross -VII (GW-496 x NIAW-301) |            | P1             | 54.16 ± 1.57         | 42.11 ± 0.76        | 12.80 ± 0.18             | 35.16 ± 1.04    |
|                                             |            | P2             | 58.66** ± 3.44       | 43.03 ± 1.06        | 12.81 ± 0.25             | 30.50 ± 0.50    |
|                                             |            | F1             | 52.33 ± 1.66         | 48.04 ± 1.73        | 13.92** ± 0.22           | 39.16** ± 0.79  |
|                                             |            | F2             | 57.00 ± 2.42         | 46.74 ± 2.54        | 13.83** ± 0.29           | 37.50** ± 0.61  |
|                                             |            | BC1            | 58.00* ± 2.16        | 44.13 ± 1.24        | 12.30 ± 0.20             | 36.66* ± 2.40   |
|                                             |            | BC2            | 57.50* ± 2.63        | 46.02 ± 1.49        | 12.55 ± 0.32             | 28.66 ± 0.98    |
| Pool Environment Cross -VIII (GW-496 x AKAW-4651)  |            | P1             | 56.33 ± 2.30         | 39.95 ± 0.99        | 11.69 ± 0.48             | 29.50 ± 0.50    |
|                                             |            | P2             | 56.00 ± 2.88         | 43.27 ± 0.86        | 12.08 ± 0.26             | 32.50 ± 1.20    |
|                                             |            | F1             | 52.00 ± 1.98         | 53.45** ± 2.40      | 13.16 ± 0.11             | 35.50 ± 1.14    |
|                                             |            | F2             | 52.50 ± 1.99         | 48.86* ± 1.53       | 12.55 ± 0.17             | 34.66 ± 0.98    |
|                                             |            | BC1            | 56.33 ± 2.33         | 47.53 ± 0.92        | 12.09 ± 0.16             | 32.33 ± 1.38    |
|                                             |            | BC2            | 55.66 ± 2.56         | 47.41 ± 0.96        | 12.09 ± 0.19             | 33.33 ± 0.95    |
|                                             |            | Mean           | 55                   | 44.58               | 12.52                    | 33.4             |
|                                             |            | S.E.(M)±       | 0.9                  | 1.5                 | 0.23                     | 1.06             |
|                                             |            | C.D.(5%)       | 2.51                 | 4.19                | 0.66                     | 2.95             |

Table 1(b). Mean performance of six characters recorded on plant basis of six generations for eight crosses in Pooled environmental conditions.
|                   | P     | F     | BC1   | BC2   | F       | BC1   | BC2   |
|-------------------|-------|-------|-------|-------|---------|-------|-------|
| P1                | 80.23 | 64.8  | 17.80 | 47.31 | 1.55    | 53.30 | 2.01   |
| P2                | 79.91 | 65.6  | 18.53 | 47.91 | 1.65    | 52.95 | 1.71   |
| F1                | 90.73 | 8.68  | 60.73 | 63.06 | 1.76    | 60.11 | 1.95   |
| F2                | 88.96 | 7.90  | 62.15 | 57.05 | 1.65    | 65.38 | 1.67   |
| BC1               | 80.25 | 6.86  | 18.86 | 52.95 | 1.71    | 54.00 | 1.70   |
| BC2               | 80.01 | 6.96  | 19.13 | 53.30 | 2.01    | 54.13 | 1.70   |
| P1                | 79.65 | 4.95  | 18.63 | 53.45 | 1.38    | 14.56 | 0.34   |
| P2                | 80.65 | 6.08  | 20.53 | 54.11 | 1.43    | 14.82 | 0.32   |
| F1                | 86.61 | 8.61  | 20.78 | 63.06 | 1.76    | 16.8  | 0.40   |
| F2                | 88.26 | 7.93  | 60.11 | 61.01 | 1.75    | 16.21 | 0.40   |
| BC1               | 81.96 | 7.58  | 19.26 | 65.70 | 1.65    | 15.17 | 0.20   |
| BC2               | 85.28 | 7.06  | 19.63 | 57.05 | 1.66    | 15.43 | 0.24   |
| P1                | 74.06 | 5.33  | 18.96 | 49.10 | 1.53    | 14.95 | 0.21   |
| P2                | 81.31 | 6.70  | 18.86 | 51.80 | 1.52    | 15.07 | 0.15   |
| F1                | 80.16 | 8.70  | 20.20 | 53.96 | 1.81    | 16.62 | 0.34   |
| F2                | 80.80 | 7.64  | 19.77 | 57.50 | 1.60    | 16.16 | 0.39   |
| BC1               | 76.00 | 6.93  | 18.50 | 52.21 | 1.61    | 16.01 | 0.36   |
| BC2               | 77.35 | 7.30  | 18.33 | 52.98 | 1.55    | 15.66 | 0.24   |
| P1                | 76.08 | 6.23  | 17.26 | 49.90 | 1.52    | 15.95 | 0.30   |
| P2                | 89.86 | 5.13  | 17.90 | 51.80 | 1.48    | 16.93 | 0.30   |
| F1                | 86.46 | 7.63  | 20.66 | 68.21 | 1.66    | 18.53 | 0.34   |
| F2                | 85.42 | 5.98  | 20.28 | 57.02 | 1.62    | 17.77 | 0.45   |
| BC1               | 78.21 | 6.68  | 17.90 | 52.17 | 1.54    | 16.65 | 0.32   |
| BC2               | 83.56 | 5.65  | 18.26 | 50.41 | 1.51    | 17.04 | 0.33   |
| P1                | 81.96 | 5.07  | 18.20 | 51.75 | 1.43    | 13.99 | 0.17   |
| P2                | 89.63 | 6.48  | 18.10 | 48.73 | 1.41    | 13.91 | 0.28   |
| F1                | 88.81 | 8.03  | 19.26 | 61.13 | 1.61    | 15.43 | 0.20   |
| F2                | 85.23 | 7.86  | 18.73 | 54.35 | 2.04    | 15.32 | 0.43   |
| BC1               | 79.63 | 6.61  | 18.46 | 52.13 | 1.47    | 14.97 | 0.27   |
| BC2               | 79.13 | 6.81  | 18.00 | 50.30 | 1.49    | 14.60 | 0.17   |
| Characters | Days to heading | 1000 seed weight | Protein content | Sedimentation value | Beta carotene |
|------------|----------------|------------------|----------------|-------------------|--------------|
|            |                |                  |                |                   |              |
| Pool Environment Cross - I (AKW-619 x DBW-31) |            |                  |                |                   |              |
| A          | 2.33 ± 4.43    | 1.64 ± 2.15      | -2.44** ± 0.55 | -3.83** ± 1.60    | -0.02 ± 0.82 |
| B          | -0.05 ± 5.31   | 0.47 ± 2.80      | -1.66** ± 0.76 | -8.16** ± 1.93    | -1.12 ± 0.63 |
| C          | -7.16 ± 8.06   | -2.48 ± 7.85     | -2.29 ± 1.79   | -3.33 ± 5.47      | 2.77* ± 1.13 |
| D          | -4.72 ± 4.10   | -2.30 ± 3.70     | 0.90 ± 0.83    | 4.33 ± 2.53       | 1.96** ± 0.65 |
| Pool Environment Cross - II (AKAW-3997 x AKAW-3722) |            |                  |                |                   |              |
| A          | 1.16 ± 6.53    | 0.77 ± 7.9       | -1.32** ± 0.57 | -11.00** ± 2.49   | 0.54 ± 0.67  |
| B          | 1.59 ± 4.75    | -0.31 ± 0.73     | -4.33* ± 1.74  | 1.06 ± 1.60       |              |
| C          | -5.83 ± 10.07  | 7.30 ± 15.64     | 3.25* ± 1.42   | -14.00** ± 5.23   | 3.38** ± 1.20 |
| D          | -3.50 ± 6.14   | 2.46 ± 7.07      | 2.45** ± 0.75  | 0.66 ± 2.24       | 0.89 ± 1.02  |
| Pool Environment Cross - III (HI-1418 x LOK-54) |            |                  |                |                   |              |
| A          | 0.16 ± 2.85    | 7.28 ± 4.38      | 0.96 ± 0.48    | -3.83* ± 1.77     | -0.25 ± 0.75 |
| B          | 1.33 ± 3.08    | 4.38 ± 4.08      | -0.49 ± 0.64   | -3.83 ± 1.83      | -1.48 ± 0.54 |
| C          | -5.00 ± 8.55   | 6.52 ± 8.06      | -0.76 ± 1.67   | -5.33 ± 4.54      | 2.39 ± 1.18  |
| D          | -0.50 ± 3.94   | -2.57 ± 2.43     | -0.61 ± 0.81   | 1.16 ± 1.70       | 2.06 ± 0.65  |
| Pool Environment Cross - IV (AKAW-3997 x NIAW-34) |            |                  |                |                   |              |
| A          | 1.50 ± 5.38    | 0.29 ± 4.12      | -1.05 ± 0.65   | -6.33** ± 2.55    | 0.11 ± 1.16  |
| B          | -0.53 ± 4.63   | -3.15 ± 2.81     | -0.81 ± 0.47   | -9.33** ± 2.27    | -0.94 ± 0.52 |
| C          | -4.83 ± 11.84  | 6.24 ± 7.80      | 1.38 ± 1.01    | -7.00 ± 4.19      | 4.70** ± 1.69 |
| D          | -3.00 ± 5.97   | 4.55 ± 3.98      | 1.62** ± 0.56  | 4.33 ± 2.21       | 2.76** ± 0.99 |
| Pool Environment Cross - V (DL-788-2 x AKAW-3722) |            |                  |                |                   |              |
| A          | -1.00 ± 2.30   | 2.40 ± 3.58      | -0.46 ± 0.61   | 2.50 ± 2.89       | 0.20 ± 0.94  |
| B          | -2.50 ± 5.01   | 1.47 ± 6.57      | -0.05 ± 0.49   | -3.00 ± 3.49      | -0.83 ± 0.69 |
| C          | -7.16 ± 7.67   | 7.80 ± 9.04      | 0.16 ± 1.17    | -4.16 ± 3.55      | 1.60 ± 1.35  |
| D          | -1.83 ± 4.25   | 1.96 ± 5.20      | 0.34 ± 0.50    | -1.83 ± 2.47      | 1.12 ± 0.80  |
| Pool Environment Cross - VI (AKAW-2978-12 x PHS-0722) |            |                  |                |                   |              |
| A          | 3.33 ± 4.31    | -6.62** ± 2.41   | 1.53** ± 0.57  | -2.50 ± 1.73      | -0.51 ± 0.85 |
| B          | 4.50 ± 4.40    | -1.68 ± 2.83     | 0.21 ± 0.60    | 1.33 ± 2.83       | -0.78 ± 0.78 |
| C          | -4.50 ± 6.73   | 7.69 ± 7.79      | 1.30 ± 1.16    | -4.50 ± 6.90      | 1.40 ± 1.34  |
Table 2 (b). Scaling test results for six characters on plant basis in eight crosses for Pool environmental conditions

| Crosses | Characters | Plant height | No. of tillers per plant | No. of spikelets per spike | No. of grains per spike | Grain weight | Grain yield per plant |
|---------|------------|--------------|--------------------------|---------------------------|-------------------------|-------------|----------------------|
| **Pool Environment Cross - I (AKW-619 x DBW-31)** | A | -5.11** ± 2.21 | -1.89** ± 0.75 | -1.73 ± 1.13 | -12.15** ± 2.33 | 0.15 ± 0.09 | -1.33* ± 0.52 |
| | B | -3.22 ± 1.67 | -2.98** ± 1.00 | -0.66 ± 0.41 | -19.18** ± 2.19 | 0.24** ± 0.08 | -1.55* ± 0.61 |
| | C | 15.34** ± 2.86 | 1.56 ± 1.10 | 0.24 ± 0.12 | -14.53** ± 3.44 | 1.11** ± 0.11 | 1.73 ± 0.97 |
| | D | 11.83** ± 1.67 | 3.91** ± 0.67 | 1.32** ± 0.32 | 8.40** ± 1.67 | 0.35** ± 0.06 | 2.31** ± 0.45 |
| **Pool Environment Cross - II (AKAW-3997 x AKAW-3722)** | A | -9.23** ± 1.84 | -0.30 ± 0.65 | -0.76 ± 0.39 | -6.18** ± 2.07 | -0.11 ± 0.07 | -1.28* ± 0.59 |
| | B | -2.60 ± 1.59 | 0.23 ± 0.60 | -0.83 ± 0.45 | 3.40 ± 2.57 | -0.20* ± 0.09 | -0.71 ± 0.56 |
| | C | 3.88 ± 2.78 | -0.07 ± 0.84 | 2.73** ± 0.76 | 20.65** ± 3.57 | 0.52** ± 0.11 | 0.21 ± 1.03 |
| | D | 7.86** ± 1.30 | 0.00 ± 0.53 | 2.16** ± 0.32 | 11.71** ± 1.88 | 0.42** ± 0.07 | 1.10 ± 0.57 |
| **Pool Environment Cross - III (HI-1418 x LOK-54)** | A | 17.66** ± 2.10 | 1.05* ± 0.42 | 2.66** ± 0.40 | 18.06** ± 1.85 | -0.12 ± 0.07 | 1.50** ± 0.53 |
| | B | 8.26** ± 1.47 | 1.05* ± 0.42 | 2.66** ± 0.40 | 18.06** ± 1.85 | -0.12 ± 0.07 | 1.50** ± 0.53 |
| **Pool Environment Cross - IV (AKAW-3997 x NIAW-34)** | A | -10.46** ± 2.57 | -1.45** ± 0.53 | -1.73** ± 0.53 | -2.15 ± 2.41 | -0.16* ± 0.08 | -0.94 ± 0.71 |
| | B | -10.61** ± 1.82 | -1.36** ± 0.49 | -1.93** ± 0.51 | -2.05 ± 2.49 | 0.35** ± 0.09 | -0.59 ± 0.57 |
| | D | 14.25** ± 3.79 | -0.71 ± 0.68 | 1.66** ± 0.85 | 31.92** ± 3.57 | -0.04 ± 0.14 | 1.49 ± 1.00 |
| **Pool Environment Cross - V (DL-788-2 x AKAW-3722)** | A | -1.23 ± 2.01 | 1.00 ± 0.62 | -0.80 ± 0.51 | -5.12 ± 2.57 | 0.14 ± 0.10 | -1.01 ± 0.66 |
| | B | 3.30 ± 1.94 | -0.57 ± 0.61 | -1.96** ± 0.54 | -3.08* ± 2.78 | 0.12 ± 0.09 | -0.76 ± 0.71 |
| | D | 19.55** ± 3.45 | 3.48** ± 0.93 | -3.54** ± 0.83 | 6.77 ± 3.66 | 0.62** ± 0.12 | 0.49 ± 1.22 |
| **Pool Environment Cross - VI (AKAW-2978-12 x PHS-0722)** | A | -6.11** ± 1.26 | -0.50 ± 0.39 | -2.13** ± 0.42 | -13.78** ± 1.94 | -0.09 ± 0.08 | -1.18 ± 0.80 |
| | B | -9.20** ± 1.43 | -1.46** ± 0.34 | -2.03** ± 0.41 | -19.18** ± 1.91 | -0.11 ± 0.09 | -1.39 ± 0.82 |
| Characters | M     | d     | h     | i     | j     | l     | Nature of gene action |
|-----------|-------|-------|-------|-------|-------|-------|-----------------------|
| Crosses   |       |       |       |       |       |       |                       |
| I         | 54.63** ± 1.49 | -0.06 ± 1.48 | -2.82 ± 2.54 |       |       |       |                       |
| II        | 57.16** ± 1.64 | -0.27 ± 1.7 | -3.29 ± 2.75 |       |       |       |                       |
| III       | 55.49** ± 1.04 | -0.96 ± 0.85 | -4.38** ± 1.66 |       |       |       |                       |
| IV        | 58.29** ± 1.24 | -0.77 ± 1.21 | -3.21 ± 2.49 |       |       |       |                       |
| V         | 53.34** ± 1.01 | 0.39 ± 1.02 | -1.96 ± 1.27 |       |       |       |                       |
| VI        | 57.52** ± 1.20 | 0.58 ± 1.22 | -2.55 ± 2.06 |       |       |       |                       |
| VII       | 57.56** ± 1.59 | -2.32 ± 1.6 | -3.75 ± 2.44 |       |       |       |                       |
| VIII      | 56.34** ± 1.60 | 0.31 ± 1.62 | -4.09 ± 2.69 |       |       |       |                       |
| Crosses   | 1000 seed wt. (g) |       |       |       |       |       |                       |
| I         | 43.00** ± 0.37 | -0.43 ± 0.35 | -0.51 ± 1.07 |       |       |       |                       |
| II        | 46.01** ± 1.90 | 0.17 ± 1.71 | 2.20 ± 3.41 |       |       |       |                       |
| III       | 42.74** ± 0.75 | -1.81* ± 0.70 | 12.43** ± 1.90 |       |       |       |                       |
| IV        | 36.82** ± 0.63 | 0.08 ± 0.63 | 7.78** ± 1.63 |       |       |       |                       |
| V         | 41.97** ± 0.65 | -2.17** ± 0.64 | 9.77** ± 1.77 |       |       |       |                       |
| VI        | 44.3* ± 1.75 | -2.64 ± 1.36 | -9.15 ± 7.72 | -16.00* ± 7.53 | -2.46 ± 1.49 | 24.31* ± 9.51 | Duplicate |
| VII       | 42.6** ± 0.63 | -0.61 ± 0.62 | 5.29** ± 1.55 |       |       |       |                       |
| VIII      | 41.68* ± 0.64 | -1.30* ± 0.59 | 12.00** ± 1.58 |       |       |       |                       |
| Crosses   | Protein content (%) |       |       |       |       |       |                       |
| I         | 12.65** ± 0.38 | 0.03 ± 0.31 | 0.02 ± 1.72 | -1.80 ± 1.66 | -0.39 ± 0.359 | 5.90** ± 2.20 | Complimentary |
| II        | 13.57** ± 0.32 | -0.67 ± 0.39 | -2.43 ± 1.53 | -4.90** ± 1.50 | -0.50 ± 0.44 | 6.54** ± 2.11 | Duplicate |
| III       | 11.75** ± 0.10 | -0.24* ± 0.10 | 0.57 ± 0.28 |       |       |       |                       |
| IV        | 12.89** ± 0.22 | -0.07 ± 0.34 | -1.32 ± 1.15 | -3.24** ± 1.12 | -0.11 ± 0.398 | 5.11** ± 1.70 | Duplicate |
| V         | 11.71** ± 0.10 | -0.10 ± 0.10 | 0.75** ± 0.20 |       |       |       |                       |
| VI        | 13.81** ± 55.10 | 0.76* ± 2.17 | 1.78 ± 1.41 | 0.45 ± 0.36 | 0.66 ± 1.769 | -2.20 ± -1.20 | Duplicate |
| VII       | 13.83** ± 0.29 | -0.25* ± 0.38 | -4.48** ± 1.43 | -5.60** ± 1.41 | -0.24 ± 0.412 | 9.35** ± 2.008 | Duplicate |
| VIII      | 12.55** ± 0.171 | -0.03 ± 0.259 | -0.53 ± 0.91 | -1.84* ± 0.85 | 0.19 ± 0.378 | 3.58* ± 1.38 | Duplicate |
| Crosses   | Sedimentation value (ml) |       |       |       |       |       |                       |
| I         | 32.33** ± 1.20 | 1.66* ± 0.80 | -2.00 ± 5.23 | -8.66 ± 5.06 | 2.16** ± 0.88 | 20.66** ± 6.35 | Duplicate |
| II        | 28.16** ± 1.04 | -0.33 ± 0.80 | -4.66 ± 4.75 | -1.33 ± 4.48 | -3.33** ± 1.23 | 16.66** ± 6.14 | Duplicate |
Table 3(b). Estimates of generation mean components in eight crosses on plant basis characters over the Pool environmental condition

| No. of tillers per plant | Plant height (cm) | D | h | i | j | l | Nature of gene action |
|--------------------------|-------------------|---|---|---|---|---|-----------------------|
| I                        | 9.63±0.20         | -0.55±0.53  | -5.01±1.40 | -7.83±1.35 | -0.15±0.59 | 14.10±2.42  | Duplicate |
| II                       | 6.17±0.12         | 0.33±0.13   | 2.50±0.22  |              |              |              | Complimentary |
| III                      | 7.44±0.13         | -0.10±0.31  | 0.04±0.85  | -2.11±0.83  | -0.04±0.35  | 4.92±1.43   | Duplicate |
| IV                       | 7.93±0.15         | 0.51±0.34   | 0.64±0.98  | -2.45±0.91  | 1.08±0.37   | 1.42±1.66   | Complimentary |
| V                        | 7.64±0.14         | -0.36±0.36  | 0.57±0.98  | -2.11±0.93  | 0.31±0.39   | 3.07±1.70   | Complimentary |
| VI                       | 5.98±0.11         | 1.03±0.21   | 2.66±0.66  | 0.71±0.63   | 0.48±0.24   | 1.25±1.04   | Complimentary |
| VII                      | 7.86±0.10         | -0.20±0.34  | -2.34±0.83 | -4.60±0.80  | 0.50±0.37   | 5.35±1.49   | Complimentary |
| VIII                     | 7.07±0.20         | 0.31±0.20   | 2.03±0.39  |              |              |              | Complimentary |

| Crosses | No. of spikelets per spike |
|---------|-----------------------------|
| I       | 19.04±0.11                  | -0.76±0.23  | -1.27±0.86  | -2.64±0.65  | -0.53±0.59  | 5.04±1.54   | Duplicate |
| II      | 19.81±0.13                  | 0.26±0.20   | -2.33±0.71  | -4.33±0.65  | 0.03±0.26   | 5.93±1.10   | Duplicate |
| III     | 20.33±0.14                  | -0.26±0.27  | -1.83±0.86  | -5.33±0.80  | 0.10±0.32   | 9.00±1.38   | Duplicate |
| IV      | 19.25±0.13                  | -0.36±0.27  | 1.89±0.84   | 0.77±0.78   | 0.58±0.32   | 1.98±1.37   | Complimentary |
| V       | 19.77±0.22                  | 0.16±0.31   | -4.16±1.12  | -5.44±1.08  | 0.11±0.36   | 10.01±1.65  | Duplicate |
| VI      | 20.77±0.14                  | -0.36±0.22  | -5.69±0.76  | -8.78±0.72  | -0.05±0.25  | 12.94±1.18  | Duplicate |
| VII     | 18.73±0.13                  | 0.46±0.23   | -0.88±0.74  | -2.00±0.71  | 0.41±0.25   | 3.90±1.14   | Duplicate |
| VIII    | 19.51±0.17                  | -0.23±0.26  | -6.61±0.9   | -9.20±0.86  | 0.01±0.28   | 15.83±1.35  | Duplicate |

| Crosses | No. of grains per earhead |
|---------|---------------------------|
| I       | 48.96±0.58                | 0.13±1.19   | -7.93±3.57  | -16.80±3.34 | 3.51±1.45   | 48.13±5.89  | Duplicate |
| II      | 58.35±0.65                | -2.68±1.35  | -12.10±3.94 | -23.43±3.75 | -4.79±1.45  | 26.21±6.48  | Duplicate |
| III     | 62.15±0.61                | -0.35±3.8    | -23.00±3.9  | -36.12±3.70 | -0.05±1.55  | 40.32±6.59  | Duplicate |
| IV      | 60.11±0.65                | -1.35±1.62  | -5.68±4.35  | -14.96±4.16 | -1.01±1.70  | 23.16±7.44  | Duplicate |
| V       | 57.55±0.77                | -0.76±1.32  | -16.08±4.41 | -19.60±4.08 | 0.58±1.52   | 18.03±6.99  | Duplicate |
4. Conclusion

The present investigation concluded that early segregating generation used for Biparental mating and/or mating which help in developing wheat population, which upon selection will result into high yielding varieties.

References

[1] Government of India, “Load Generation Balance Report 2011-12”, A Report by Central Electricity Authority (CEA), Ministry of Power, available at http://www.cea.nic.in/reports/yearly/lgbr_report.pdf
[2] Verma V. S., “Energy Efficient Technologies Use in India-An Overview 2004”, Bureau of Energy Efficiency (BEE), 20 August 2004.
[3] Sayeed P. M., “Energy Conservation in India, on 14th December 2005”, Ministry of Power, Government of India, available at http://www.powermin.nic.in/whats_new/pdf/Ministers_artificial.pdf
[4] Energy Value-Efficiency Improvement Initiatives by HT Consumers”, Power Line, Volume 16, No. 7, March 2012, pp. 51.
[5] Kalyanaraman M., “Target High Tension Users for More Energy Efficiency”, The Times of India, 25 April 2011.
[6] Ravi Babu P., “Water Demand Side Management through Fuzzy Logic”, CISCON National Conference, Manipal Institute of Technology, Manipal, 02-03 October 2006.
[7] Arno Middleberg, Jianglei Zhang and Xiaohua Xia, “An Optimal Control Model for Load Shifting-With Application in the Energy Management of a Colliery”, Applied Energy, 86 (07-08), pp. 1266-1273, July 2009.
[8] Yik F. W. H. and Lee W. L., “Rebate as an Economic Instrument for Promoting Building Energy Efficiency I Hong Kong”, Building and Environment, Volume 40, Issue 9, September 2005, pp. 1207-1216.
[9] ABPS Infrastructure Advisory Private Limited, “Approach Paper for MERC MYT Regulations-FY 2010-11 to 2014-15”, pp. 275-277.
[10] Maharashtra State Electricity Distribution Company Limited, HT Tariff Booklet, available at http://www.mahadiscom.in/tariff/Tariff-Booklet-high-may07.pdf
[11] Madhya Pradesh Electricity Regulatory Commission, Tariff Order, available at http://www.mpervc.nic.in/310312-Final-Tariff-Order-FY-2012-13-LV-HV-SCH.pdf, pp. 195-219
[12] Andhra Pradesh Central Power Distribution Company Limited, Retail Supply Tariff Schedule for FY 2011-12, available at http://www.apcentralpower.com/tariffs/tariffs.jsp, pp. 01-07.
[13] Tamil Nadu Electricity Regulatory Commission, “Determination of Tariff for Generation and Distribution”, Order No. 1 of 2012-dated 30-03-2012, available at http://www.tangedco.gov.in/linkpdf/T. O No. 1.pdf, pp. 319-324.
[14] Gujarat Electricity Regulatory Commission, Part II, Tariff for Supply of Electricity at HT and EHT, available at http://www.gercm.org/tarifforderpdf/en_1304750473.pdf, pp. 180-192.