

## ***RESULTS AND DISCUSSION***

The present study was carried out to investigate the heterosis and types of gene action for some growth and yield characteristics of some parental wheat lines and / or varieties by means of diallel cross system . To achieve this target , half diallel of F1 and F2 crosses was studied .

### **A- Analysis of variance, means, and heterosis .**

#### **1- F1 - generation : -**

The analysis of variance for each of the two seasons as well as the combined data for growth, yield and its components is presented in Table ( 6 ). The error variance for the two seasons were homogenous for all the traits studied, consequently the combined analysis would be valid. Season mean squares were significant for all the studied traits except height up to flag leaf . Indicating an overall differences between the two seasons . Also, the mean values in the second season were higher than those in the first one , for all the traits except for plant height up to peduncle leaf, region length of peduncle, straw yield , total plant weight, 1000- Kernel weight , spike length and grain yield per plant, whereas the highest mean values were obtained in the first season . It could be concluded that the grain yield increase in the second season may be due to the significant increase in the 1000-kernel weight. Also , the straw yield increase in the first season may be due to significant increase in plant height, length of peduncle leaf and total plant weight.

Significant genotypes mean squares were detected for all the studied traits in separate season as well as the combined analysis , indicating the wide diversity between the parental materials used in the present study . Significant genotypes x season interaction mean squares were obtained for all the studied traits except heading date , and flag leaf area . Such results indicated that the tested genotypes varied from each other, and ranked differently from season to another.

**Table (6) : Observed mean squares from analysis of variance for all traits studied for F1.**

| Source of variation | Degrees of freedom |     | Heading date (days)   |                      |                      | Physiological matur date (days) |                     |                      | Plant height (cm)     |                       |                       | Height up to flag leaf (cm) |                      |                      |
|---------------------|--------------------|-----|-----------------------|----------------------|----------------------|---------------------------------|---------------------|----------------------|-----------------------|-----------------------|-----------------------|-----------------------------|----------------------|----------------------|
|                     | S                  | C   | S1                    | S2                   | C                    | S1                              | S2                  | C                    | S1                    | S2                    | C                     | S1                          | S2                   | C                    |
| Season              | -                  | 1   |                       |                      | 132.87 <sup>**</sup> |                                 |                     | 141.72 <sup>**</sup> |                       |                       | 208.40                |                             |                      | 0.67                 |
| Rep. with s         | 2                  | 4   | 4.25                  | 5.81                 | 10.06                | 2.25                            | 11.75               | 7.00                 | 1.06                  | 2.00                  | 1.53                  | 4.78                        | 3.59                 | 4.18                 |
| Genotype            | 44                 | 44  | 55.97 <sup>**</sup>   | 57.08 <sup>**</sup>  | 112.56 <sup>**</sup> | 39.49 <sup>**</sup>             | 18.86 <sup>**</sup> | 46.51 <sup>**</sup>  | 381.66 <sup>**</sup>  | 317.70 <sup>**</sup>  | 678.22 <sup>**</sup>  | 260.68 <sup>**</sup>        | 256.08 <sup>**</sup> | 470.77 <sup>**</sup> |
| Parent              | 8                  | 8   | 117.78 <sup>**</sup>  | 110.75 <sup>**</sup> | 228.34 <sup>**</sup> | 32.60 <sup>**</sup>             | 33.31 <sup>**</sup> | 65.64 <sup>**</sup>  | 687.92 <sup>**</sup>  | 559.60 <sup>**</sup>  | 1241.32 <sup>**</sup> | 455.64 <sup>**</sup>        | 449.59 <sup>**</sup> | 899.08 <sup>**</sup> |
| F1                  | 35                 | 35  | 38.92 <sup>**</sup>   | 41.81 <sup>**</sup>  | 80.17 <sup>**</sup>  | 39.71 <sup>**</sup>             | 15.31 <sup>**</sup> | 40.51 <sup>**</sup>  | 289.12 <sup>**</sup>  | 237.91 <sup>**</sup>  | 501.88 <sup>**</sup>  | 213.06 <sup>**</sup>        | 206.23 <sup>**</sup> | 362.94 <sup>**</sup> |
| P.V.S F1            | 1                  | 1   | 158.027 <sup>**</sup> | 162.14 <sup>**</sup> | 319.76 <sup>**</sup> | 86.64 <sup>**</sup>             | 27.52 <sup>**</sup> | 104.60 <sup>**</sup> | 1170.50 <sup>**</sup> | 1175.27 <sup>**</sup> | 234.34 <sup>**</sup>  | 367.88 <sup>**</sup>        | 452.58 <sup>**</sup> | 818.27 <sup>**</sup> |
| GXS                 |                    | 44  |                       |                      | 0.49                 |                                 |                     | 11.83 <sup>**</sup>  |                       |                       | 21.14 <sup>**</sup>   |                             |                      | 45.99 <sup>**</sup>  |
| PXS                 |                    | 8   |                       |                      | 0.200                |                                 |                     | 0.26                 |                       |                       | 6.19 <sup>*</sup>     |                             |                      | 6.15                 |
| FXS                 |                    | 35  |                       |                      | 0.56                 |                                 |                     | 14.53 <sup>**</sup>  |                       |                       | 25.15 <sup>**</sup>   |                             |                      | 56.34 <sup>**</sup>  |
| P.V.S FXS           |                    | 1   |                       |                      | 0.14                 |                                 |                     | 9.56 <sup>*</sup>    |                       |                       | 0.39                  |                             |                      | 2.19                 |
| Error               | 88                 | 176 | 1.20                  | 1.93                 | 1.56                 | 2.13                            | 2.45                | 2.29                 | 2.09                  | 2.18                  | 2.13                  | 5.33                        | 12.05                | 8.69                 |

\* and \*\* significant at 0.05 and 0.01 levels of probability, respectively.  
s, s<sub>1</sub>, s<sub>2</sub> and c: first, second seasons and the combined analysis, respectively

**Table ( 6 ) : Observed mean squares from analysis of variance for all traits studied for F1.**

| Table ( 6 ) : Observed mean squares from analysis of variance for all traits studied for F1. |                    |     |                            |        |        |    |                                   |       |        |    |                             |       |        |       |                            |       |              |  |
|----------------------------------------------------------------------------------------------|--------------------|-----|----------------------------|--------|--------|----|-----------------------------------|-------|--------|----|-----------------------------|-------|--------|-------|----------------------------|-------|--------------|--|
| Source of variation                                                                          | Degrees of freedom |     | Height of flag region (cm) |        |        |    | Flag leaf area (cm <sup>2</sup> ) |       |        |    | Number of tillers per plant |       |        |       | Number of spikes per plant |       |              |  |
|                                                                                              | S                  | C   | S1                         | S2     | C      | S1 | S2                                | C     | S1     | S2 | C                           | S1    | S2     | C     | S1                         | S2    | C            |  |
| Season                                                                                       | -                  | 1   |                            |        | 255.17 |    |                                   |       |        |    | 128.45                      |       |        | 44.53 |                            |       | ** 108712.29 |  |
| R with s                                                                                     | 2                  | 4   | 6.99                       | 7.49   | 3.48   |    | 0.57                              | 0.54  | 0.55   |    | 0.004                       | 0.64  | 0.32   |       | 1.71                       | 0.42  | 1.06         |  |
| Genotype                                                                                     | 44                 | 44  | 72.75                      | 40.06  | 66.04  |    | 60.33                             | 53.55 | 109.89 |    | 15.73                       | 16.48 | 12.18  |       | 16.98                      | 8.46  | 13.19        |  |
| Parent                                                                                       | 8                  | 8   | 29.34                      | 20.84  | 44.91  |    | 67.77                             | 70.45 | 135.93 |    | 12.89                       | 26.99 | 27.16  |       | 9.63                       | 4.08  | 9.54         |  |
| F1                                                                                           | 35                 | 35  | 78.08                      | 41.13  | 61.63  |    | 56.28                             | 48.66 | 100.52 |    | 7.29                        | 12.02 | 7.98   |       | 7.72                       | 9.70  | 8.66         |  |
| P.V.S F1                                                                                     | 1                  | 1   | 233.41                     | 156.37 | 389.78 |    | 142.54                            | 89.91 | 229.33 |    | 333.86                      | 88.74 | 39.18  |       | 399.90                     | 0.032 | 201.14       |  |
| GXS                                                                                          | -                  | 44  |                            |        | 46.76  |    |                                   |       | 3.99   |    |                             |       | 20.04  |       |                            |       | 12.25        |  |
| PXS                                                                                          | -                  | 8   |                            |        | 5.26   |    |                                   |       | 2.28   |    |                             |       | 12.72  |       |                            |       | 4.26         |  |
| F1XS                                                                                         | -                  | 35  |                            |        | 57.58  |    |                                   |       | 4.41   |    |                             |       | 11.33  |       |                            |       | 8.26         |  |
| P.V.S F1XS                                                                                   | -                  | 1   |                            |        | 0.07   |    |                                   |       | 3      |    |                             |       | 383.42 |       |                            |       | 198.78       |  |
| Error                                                                                        | 88                 | 176 | 5.07                       | 8.87   | 6.97   |    | 4.24                              | 3.71  | 3.06   |    | 1.62                        | 2.16  | 1.89   |       | 1.95                       | 1.66  | 1.80         |  |

\* and \*\* significant at 0.05 and 0.01 levels of probability, respectively.  
S<sub>1</sub>, S<sub>2</sub> and C: first, second seasons and the combined analysis, respectively

**Table (6) : Observed mean squares from analysis of variance for all traits studied for F1.**

| Source of variation | Degrees of freedom |     | Spike length ( cm) |         |            | Number of spikelets per spike |         |         | Number of grains per spike |          |           | 1000- kernel weight (gm) |          |          |
|---------------------|--------------------|-----|--------------------|---------|------------|-------------------------------|---------|---------|----------------------------|----------|-----------|--------------------------|----------|----------|
|                     | S                  | C   | S1                 | S2      | C          | S1                            | S2      | C       | S1                         | S2       | C         | S1                       | S2       | C        |
| Season              | -                  | 1   |                    |         | 53261.67** |                               |         | 76.08** |                            |          | 5824.18** |                          |          | 314.76** |
| R with s            | 2                  | 4   | 1.28               | 0.22    | 0.75       | 0.29                          | 0.51    | 0.80    | 11.43                      | 2.28     | 6.85      | 28.56                    | 87.21    | 57.88    |
| Genotype            | 44                 | 44  | 1.91**             | 1.74**  | 2.78**     | 1.51**                        | 2.37**  | 2.76**  | 169.44**                   | 93.30**  | 79.49**   | 20.92**                  | 33.87**  | 34.99**  |
| Parent              | 8                  | 8   | 1.90**             | 1.66**  | 2.25**     | 1.49**                        | 1.36**  | 1.02**  | 149.66**                   | 160.88** | 157.85**  | 9.04**                   | 45.26**  | 36.93**  |
| F1                  | 35                 | 35  | 0.97**             | 1.28**  | 1.51**     | 2.08**                        | 2.14**  | 2.44**  | 129.69**                   | 56.85**  | 84.26**   | 20.15**                  | 25.82**  | 25.18**  |
| P.V.S F1            | 1                  | 1   | 34.97**            | 18.31** | 51.64**    | 9.02**                        | 20.60** | 27.95** | 1719**                     | 828.40** | 80.21**   | 142.74**                 | 224.52** | 362.59** |
| GXS                 |                    | 44  |                    |         | 0.86*      |                               |         | 1.11**  |                            |          | 165.24**  |                          |          | 19.80**  |
| PXS                 |                    | 8   |                    |         | 1.30**     |                               |         | 1.82**  |                            |          | 152.96**  |                          |          | 17.37**  |
| FIXS                |                    | 35  |                    |         | 0.73*      |                               |         | 0.93**  |                            |          | 102.28**  |                          |          | 20.79**  |
| P.V.S FIXS          |                    | 1   |                    |         | 1.64**     |                               |         | 1.66**  |                            |          | 2467.19** |                          |          | 4.67     |
| Error               | 88                 | 176 | 0.22               | 0.07    | 0.14       | 0.17                          | 0.12    | 0.14    | 9.43                       | 6.85     | 8.14      | 5.63                     | 4.44     | 5.04     |

\* and \*\* significant at 0.05 and 0.01 levels of probability, respectively.  
S, S<sub>1</sub>, S<sub>2</sub> and c: first, second seasons and the combined analysis, respectively

**Table (6) : Observed mean squares from analysis of variance for all traits studied for F1.**

| Source of variation | Degrees of freedom |     | Grain yield per plant (g) |           |           | Straw yield per plant (g) |           |            | Harvest index |         |          | Total plant weight (gm) |          |           |
|---------------------|--------------------|-----|---------------------------|-----------|-----------|---------------------------|-----------|------------|---------------|---------|----------|-------------------------|----------|-----------|
|                     | S                  | C   | S1                        | S2        | C         | S1                        | S2        | C          | S1            | S2      | C        | S1                      | S2       | C         |
| Season              |                    | 1   |                           |           | 675.70**  |                           |           | 190433.2** |               |         | 84.45**  |                         |          | 114221.12 |
| R with s            | 2                  | 4   | 22                        | 2.75      | 12.37     | 29.62                     | 22.51     | 26.06      | 0.0007        | 0.0008  | 0.0007   | 5.75                    | 7.25     | 6.50      |
| Genotype            | 44                 | 44  | 361.01**                  | 431.59**  | 405.07**  | 780.26**                  | 74.57**   | 754.37**   | 0.009**       | 0.020** | 0.0137** | 1063.24**               | 591.68** | 953.93**  |
| Parent              | 8                  | 8   | 594.70**                  | 176.56**  | 565.40**  | 503.16**                  | 614.88**  | 962.18**   | 0.010**       | 0.010** | 0.0186** | 1224.72**               | 676.64** | 1206.27** |
| F1                  | 35                 | 35  | 275.61**                  | 390.33**  | 371.73**  | 256.25**                  | 744.98**  | 572.01**   | 0.002**       | 0.020** | 0.0129** | 733.73**                | 575.63** | 689.02**  |
| P.V.S F1            | 1                  | 1   | 1480.64**                 | 3908.71** | 289.20**  | 2133.73**                 | 1680.23** | 5474.41**  | 0.240**       | 0.110** | 0.0034** | 11304.01**              | 473.81** | 8207.10** |
| GXS                 |                    | 4   |                           |           | 387.53**  |                           |           | 768.45**   |               |         | 0.0154** |                         |          | 700.99**  |
| PXS                 |                    | 8   |                           |           | 205.88**  |                           |           | 155.68**   |               |         | 0.002**  |                         |          | 695.09**  |
| F1XS                |                    | 35  |                           |           | 294.40**  |                           |           | 429.21**   |               |         | 0.0091** |                         |          | 620.33**  |
| P.V.S F1XS          |                    | 1   |                           |           | 5100.15** |                           |           | 1754.55**  |               |         | 0.346**  |                         |          | 3570.72** |
| Error               | 88                 | 176 | 40.22                     | 10.14     | 25.18     | 31.84                     | 31.84     | 28.12      | 0.0006        | 0.0007  | 0.0006   | 42.10                   | 15.61    | 28.85     |

\* and \*\* significant at 0.05 and 0.01 levels of probability, respectively.

S, S<sub>1</sub>, S<sub>2</sub> and C: first, second seasons and the combined analysis, respectively

For two exceptional two traits significant genotypes mean squares along with insignificant genotypes x season interaction mean squares were detected . These findings , therefore, might revealed the high repeatability of the tested genotypes under different seasons. Also , it may reflect the minor role of the none additive type of gene action on the expression of these traits .

Results also, showed that mean squares due to parents were significant for all the studied traits. Significant mean squares due to interaction between parental varieties and seasons were detected for all the traits except for heading date, physiological mature date , height up to flag leaf , height of flag region and flag leaf area. These findings indicate that parental varieties and /or lines differed in their mean performance in all traits under test . Also, it revealed that parental line varied in their response to seasonal in all traits except for heading date , maturity date , height up to flag leaf , height of flag region and flag leaf area.

The mean performances of the nine parental lines and / or varieties of wheat at separate season as well as the combined data are presented in (Table 7) The parental lines R.C.B33 behaved as the latest one for earliness ( heading and maturity dates.). It was the top of the tested parental lines in harvest index , number of spikelets per spike in the combined analysis . R.C.B70 was the top of the tested parental lines in grain yield per plant , harvest index and number of grains per spike . It gave the lowest mean values for plant height . The parental line No. 1 gave the lowest mean value for total plant weight and grain yield per plant , it was intermediate in other traits . The parental line R.C.B56 was on the top of the tested parental lines in total plant weight and spike length. Meanwhile, it almost expressed moderate values for the most of other traits . Sakha 69 behaved as earliest one for heading date . R.C.B122 gave the lowest mean values for number of tillers per plant , number of spikes per plant . Meanwhile it ranked second of the tested parental lines for late of maturity . R.C.B143 was on the top of the tested parental lines in

Table ( 7 ): The genotype mean performance (  $S_1$ ,  $S_2$  and C ) for all parents and crosses studied in F1 generation .

| Genotype      | Heading date ( days ) |                       |                       | Physiological maturity date (days) |                       |                       | Plant height ( cm )  |                      |                      | Height up to flag leaf ( cm ) |                     |                      |
|---------------|-----------------------|-----------------------|-----------------------|------------------------------------|-----------------------|-----------------------|----------------------|----------------------|----------------------|-------------------------------|---------------------|----------------------|
|               | $S_1$                 | $S_2$                 | C                     | $S_1$                              | $S_2$                 | C                     | $S_1$                | $S_2$                | C                    | $S_1$                         | $S_2$               | C                    |
| P1 (Dennia 1) | 124.4 <sup>f</sup>    | 125.9 <sup>c d</sup>  | 125.22 <sup>d</sup>   | 188.7 <sup>ef</sup>                | 188.17 <sup>i-l</sup> | 188.12 <sup>hi</sup>  | 115.36 <sup>z</sup>  | 111.72 <sup>z</sup>  | 113.54 <sup>xz</sup> | 79.9 <sup>qr</sup>            | 80.27 <sup>m</sup>  | 80.08 <sup>p-r</sup> |
| P2 (RCB33)    | 128.33 <sup>a</sup>   | 129.17 <sup>a</sup>   | 128.75 <sup>a</sup>   | 193.13 <sup>a</sup>                | 194.10 <sup>b</sup>   | 193.61 <sup>a</sup>   | 105.97 <sup>z</sup>  | 104.66 <sup>z</sup>  | 105.31 <sup>z</sup>  | 72.33 <sup>v</sup>            | 71.9 <sup>q</sup>   | 72.11 <sup>v</sup>   |
| P3 (RCB36)    | 123.8 <sup>b</sup>    | 125.43 <sup>d</sup>   | 124.61 <sup>e</sup>   | 183.67 <sup>r</sup>                | 184.90 <sup>z</sup>   | 184.28 <sup>s</sup>   | 116.31 <sup>z</sup>  | 113.23 <sup>x</sup>  | 114.77 <sup>x</sup>  | 80.96 <sup>pq</sup>           | 77.23 <sup>n</sup>  | 79.09 <sup>rs</sup>  |
| P4 (Sakthi69) | 110.28 <sup>y</sup>   | 111.87 <sup>x</sup>   | 111.07 <sup>x</sup>   | 186.87 <sup>b-i</sup>              | 187.27 <sup>n-r</sup> | 187.07 <sup>k-n</sup> | 113.23 <sup>z</sup>  | 112.66 <sup>xy</sup> | 112.94 <sup>z</sup>  | 80.93 <sup>pq</sup>           | 81.17 <sup>m</sup>  | 81.05 <sup>op</sup>  |
| P5 (RCB70)    | 126.72 <sup>b</sup>   | 127.83 <sup>b</sup>   | 127.27 <sup>b</sup>   | 189.83 <sup>c</sup>                | 190.97 <sup>t-x</sup> | 190.40 <sup>d</sup>   | 100.61 <sup>z</sup>  | 102.42 <sup>z</sup>  | 101.5 <sup>z</sup>   | 71.31 <sup>w</sup>            | 74.83 <sup>op</sup> | 73.07 <sup>v</sup>   |
| P6 (RCB 122)  | 116.65 <sup>f</sup>   | 117.73 <sup>a-p</sup> | 117.19 <sup>m-p</sup> | 192.33 <sup>b</sup>                | 193.03 <sup>f</sup>   | 192.68 <sup>b</sup>   | 98.25 <sup>z</sup>   | 98.07 <sup>z</sup>   | 98.16 <sup>z</sup>   | 67.63 <sup>x</sup>            | 66.63 <sup>r</sup>  | 67.13 <sup>w</sup>   |
| P7 (RCB143)   | 114.67 <sup>n</sup>   | 116.4 <sup>r s</sup>  | 115.53 <sup>r s</sup> | 186.30 <sup>j-l</sup>              | 186.60 <sup>f</sup>   | 186.45 <sup>no</sup>  | 147.30 <sup>a</sup>  | 143.13 <sup>a</sup>  | 145.31 <sup>a</sup>  | 108.31 <sup>a</sup>           | 108.6 <sup>a</sup>  | 108.43 <sup>a</sup>  |
| P8 (Gua 157)  | 116 <sup>s</sup>      | 118 <sup>m-o</sup>    | 117 <sup>n-q</sup>    | 186.63 <sup>i-k</sup>              | 188.10 <sup>xz</sup>  | 187.36 <sup>j-l</sup> | 127.43 <sup>i</sup>  | 123.9 <sup>k</sup>   | 125.67 <sup>l</sup>  | 90.73 <sup>gh</sup>           | 88.30 <sup>i</sup>  | 89.51 <sup>k</sup>   |
| P9 (Gua 146)  | 116 <sup>s</sup>      | 117.33 <sup>p-q</sup> | 116.66 <sup>p q</sup> | 184.30 <sup>p-r</sup>              | 184.90 <sup>z</sup>   | 184.6 <sup>rs</sup>   | 123.22 <sup>qr</sup> | 122.13 <sup>mm</sup> | 122.67 <sup>o</sup>  | 87.37 <sup>k</sup>            | 88 <sup>i</sup>     | 87.68 <sup>l</sup>   |
| 1x2           | 116.8 <sup>qr</sup>   | 117.8 <sup>n-p</sup>  | 117.3 <sup>m-o</sup>  | 187.17 <sup>g-i</sup>              | 188.23 <sup>ik</sup>  | 187.70 <sup>b-k</sup> | 125.10 <sup>lm</sup> | 110.6 <sup>z</sup>   | 117.85 <sup>uv</sup> | 85 <sup>lm</sup>              | 75.43 <sup>o</sup>  | 80.21 <sup>p-r</sup> |
| 1x3           | 116 <sup>s</sup>      | 117.53 <sup>op</sup>  | 116.76 <sup>o-q</sup> | 186.50 <sup>j-k</sup>              | 186.93 <sup>o-t</sup> | 186.71 <sup>l-o</sup> | 127 <sup>ij</sup>    | 119 <sup>p</sup>     | 123 <sup>o</sup>     | 83.68 <sup>l</sup>            | 84.27 <sup>jk</sup> | 84.97 <sup>m</sup>   |
| 1x4           | 118.03 <sup>k-m</sup> | 118.77 <sup>kl</sup>  | 118.4 <sup>jk</sup>   | 185.50 <sup>mn</sup>               | 183.43 <sup>x-z</sup> | 183.46 <sup>pq</sup>  | 120 <sup>u</sup>     | 114.90 <sup>w</sup>  | 117.43 <sup>v</sup>  | 80.44 <sup>pq</sup>           | 78.57 <sup>n</sup>  | 79.5 <sup>qr</sup>   |
| 1x5           | 118.27 <sup>kl</sup>  | 120.07 <sup>hi</sup>  | 119.17 <sup>b</sup>   | 186.27 <sup>j-l</sup>              | 186.73 <sup>p-u</sup> | 186.30 <sup>no</sup>  | 113.7 <sup>z</sup>   | 112.10 <sup>x</sup>  | 112.92 <sup>z</sup>  | 72.78 <sup>v</sup>            | 78.27 <sup>n</sup>  | 73.52 <sup>tu</sup>  |
| 1x6           | 117.95 <sup>l-n</sup> | 119.23 <sup>gk</sup>  | 118.59 <sup>j-k</sup> | 188.50 <sup>de</sup>               | 189.17 <sup>g</sup>   | 188.83 <sup>fg</sup>  | 110 <sup>z</sup>     | 109.8 <sup>z</sup>   | 109.9 <sup>z</sup>   | 83.77 <sup>no</sup>           | 77.97 <sup>n</sup>  | 80.87 <sup>o-q</sup> |

Mean designated by the same letter are not significant different at the 5% level according to Duncan's multiple range test.

\* and \*\* significant at 0.05 and 0.01 levels of probability, respectively.

S1, S2 and C = first, second and combined analysis, respectively. r = Correlation coefficient between mild -prent and F1 performance.

Table ( 7 ): The genotype mean performance ( S<sub>1</sub>, S<sub>2</sub> and C ) for all parents and crosses studied in F1 generation .

| Genotype | Heading date ( days )\ |            |            | Physiological maturity date ( days ) |            |            | Plant height ( cm ) |           |            | Height up to flag leaf ( cm ) |          |          |
|----------|------------------------|------------|------------|--------------------------------------|------------|------------|---------------------|-----------|------------|-------------------------------|----------|----------|
|          | S1                     | S2         | C          | S1                                   | S2         | C          | S1                  | S2        | C          | S1                            | S2       | C        |
| 1x7      | 117.33 op              | 119.57 b-j | 118.45 i-k | 167.77 t                             | 186.97 o-s | 177.37 u   | 121.31 t            | 122.70 lm | 122.01 p   | 92.48 f                       | 82.97 ld | 87.72 l  |
| 1x8      | 117.33 op              | 118.90 jk  | 118.11 kl  | 182.30 s                             | 183.13 z   | 182.81 t   | 119.7 u             | 117.80 qr | 118.73 re  | 89.48 i                       | 77.93 n  | 83.7 n   |
| 1x9      | 119.64 i               | 120.73 g   | 120.18 g   | 186 k-m                              | 187.37 m-q | 186.68 l-o | 122.77 rs           | 117 s     | 119.88 q   | 85.3 t-bu                     | 87.97 i  | 86.67 l  |
| 2x3      | 125.08 o               | 126 cd     | 125.54 cd  | 185.63 l-n                           | 186.43 e-w | 186.03 op  | 123.18 rq           | 122.80 l  | 122.99 o   | 77.26 f                       | 80.87 m  | 79.06 m  |
| 2x4      | 118.46 k               | 119.33 ij  | 118.99 kl  | 184.83 o-p                           | 186 u-x    | 185.41 pq  | 123.69 pq           | 126.16 j  | 124.92 m   | 83.12 o                       | 92.37 gh | 87.74 l  |
| 2x5      | 126.08 c               | 129.03 a   | 127.55 b   | 187.83 g                             | 188.87 g-i | 188.35 gh  | 111.33 z            | 116 uv    | 113.66 z   | 83.60 no                      | 80.87 m  | 82.23 o  |
| 2x6      | 114.84 u               | 115.30 km  | 115.07 m   | 188.50 do                            | 190.33 ef  | 189.41 ef  | 105.68 z            | 106.20 z  | 105.94 z   | 72.55 v                       | 80.40 m  | 76.47 t  |
| 2x7      | 117.35 m-p             | 120.17 gh  | 118.86 b-j | 187.07 kl                            | 187.53 k-o | 187.30 j-m | 136.12 g            | 132.27 e  | 134.19 g   | 93.83 c                       | 94.70 ef | 94.26 f  |
| 2x8      | 116.08 s               | 117.53 op  | 116.8 o-q  | 184.50 o-k                           | 186.17 e-x | 185.33 q   | 118 wx              | 112.87 x  | 115.44 w   | 81.39 p                       | 77.70 n  | 79.54 qr |
| 2x9      | 119.1 j                | 120.73 g   | 119.91 g   | 186.33 j-l                           | 186.90 o-t | 186.45 no  | 122.39 s            | 115.80 v  | 119.09 r   | 87.52 l                       | 82.94 ld | 85.23 m  |
| 3x4      | 117.34 op              | 118.97 jk  | 118.15 kl  | 186.87 b-j                           | 189.07 gh  | 187.97 b-j | 125.67 kl           | 126.37 u  | 126.02 kl  | 88.17 ji                      | 95.30 e  | 91.73 hi |
| 3x5      | 119.45 ij              | 121 f      | 120.23 g   | 185 no                               | 187.20 o-s | 186.10 op  | 127.42 i            | 126.9 i   | 127.16 j   | 91.15 f                       | 93.47 g  | 92.31 gh |
| 3x6      | 110.63 y               | 111.13 y   | 110.88 x   | 186.7 i-k                            | 187.9 j-a  | 187.30 j-m | 111.50 z            | 110.07 z  | 110.78 z   | 76.29 t                       | 73.5 p   | 74.89 u  |
| 3x7      | 112.83 w               | 114.13 v   | 113.48 v   | 185.77 km                            | 186.73 p-w | 186.25 o   | 143.83 c            | 137.6 c   | 140.71 c   | 101.77 c                      | 103.73 b | 102.75 b |
| 3x8      | 111.30 x               | 112.8 w    | 112.05 w   | 192.17 do                            | 195.13 a   | 193.63 a   | 118.88 v            | 117.27 re | 118.07 t-v | 83.64 no                      | 80.57 m  | 82.1 o   |
| 3x9      | 116.36 rs              | 116.83 qr  | 116.59 q   | 183.83 qr                            | 185.93v-x  | 184.88q-s  | 124.41 no           | 122.87 l  | 123.64 n   | 89.82 hi                      | 84.97 j  | 87.39 l  |
| 4x5      | 113.92v                | 115.87st   | 114.89t    | 186.87HJ                             | 189.07gh   | 187.97b-j  | 117.67x             | 119.70o   | 118.68r-t  | 80.96pq                       | 81.47lm  | 81.21op  |

Mean designated by the same letter are not significant different at the 5% level according to Duncan's multiple range test.

\*and\*\* significant at 0.05 and 0.01 levels of probability, respectively.

S1, S2 and C = first, second and combined analysis, respectively. r = Correlation coefficient between mid-parent and F1 performance.



Table ( 7 ): The genotype mean performance (  $s_1$ ,  $s_2$  and C ) for all parents and crosses studied in F1 generation .

| Genotype  | Heading date ( days ) |            |           | Physiological maturity date (days) |            |            | Plant height ( cm ) |           |           | Height up to flag leaf (cm) |           |           |
|-----------|-----------------------|------------|-----------|------------------------------------|------------|------------|---------------------|-----------|-----------|-----------------------------|-----------|-----------|
|           | S1                    | S2         | C         | S1                                 | S2         | C          | S1                  | S2        | C         | S1                          | S2        | C         |
| 4x6       | 113.21 w              | 113.9 v    | 113.55 v  | 183.67 l-m                         | 187.47 ef  | 186.57 m-o | 127.17 ij           | 129.75 f  | 128.45 i  | 89.04 ij                    | 97.50 d   | 93.27 fg  |
| 4x7       | 117.84 l-o            | 118.8 kl   | 118.32 jk | 189.10 d                           | 190.40 r-v | 189.75 e   | 140.24 e            | 131.77 e  | 136 f     | 99.81 d                     | 91.93 h   | 95.87     |
| 4x8       | 116.82 q              | 118.21 n   | 117.51 mn | 186 k-m                            | 186.53 m   | 186.26 o   | 132.67 h            | 128.83 g  | 130.75 h  | 81.30 p                     | 93.83 e-g | 87.56 l   |
| 4x9       | 120.44 h              | 121.07 e   | 120.75 f  | 186 k-m                            | 187.23 e   | 186.61 m-o | 123.93 op           | 122 n     | 122.96 o  | 91.17 g                     | 87.80 i   | 89.48 k   |
| 5x6       | 117.47 n-p            | 119.13 jk  | 118.3 jk  | 186 k-m                            | 186.17 s-r | 186.08 o-p | 118.41 vw           | 118.40 pq | 118.4 s-o | 79.17 r                     | 84.4 jk   | 81.78 o   |
| 5x7       | 123.62 d              | 126.43 c   | 126.02 c  | 187.43 gh                          | 187.27 b-j | 187.35 v   | 111.33 z            | 114.97 w  | 113.15 xz | 74.63 u                     | 75.13 o   | 74.88 u   |
| 5x8       | 116.7 q               | 118.57 k-m | 117.63 lm | 186.83 h-j                         | 188.40 w-r | 187.61 i-k | 113.33 z            | 116.6 tu  | 115.96 w  | 75.71 t                     | 80.60 m   | 78.15 s   |
| 5x9       | 117.17 pq             | 119.47 ij  | 118.32 jk | 184.47 o-q                         | 185.67 c   | 185.07 q   | 114.4 z             | 117.37 rs | 115.88 w  | 80.85 pq                    | 83.53 jk  | 82.19 o   |
| 6x7       | 115.30 t              | 116.33 rs  | 115.91 r  | 188.83 d                           | 190.17 d   | 189.50 ef  | 142.48 d            | 134.23 d  | 138.35 e  | 99.77 d                     | 101.03 c  | 100.4 d   |
| 6x8       | 113.04 w              | 115.2 u    | 114.12 u  | 190.20 c                           | 192.27 s-x | 191.23 c   | 126.67 j            | 128.07 h  | 127.27 j  | 84.49 mn                    | 97.53 d   | 91.01 ij  |
| 6x9       | 114.18 v              | 115.5 tu   | 114.84 t  | 184 q                              | 186 q-r    | 185 q      | 125 mn              | 124.47 kl | 124.73 m  | 92.67 f                     | 87.83     | 90.25 jk  |
| 7x8       | 117.41 op             | 118.97 jk  | 118.19 kl | 187.77 fg                          | 190.20 q   | 188.98 fg  | 144.48 b            | 143.17 a  | 143.82 b  | 103.94 b                    | 100.10 c  | 102.02 bc |
| 7x9       | 111.2 x               | 112.13 x   | 111.65    | 186.83 h-j                         | 186.6 j-m  | 186.71 h-o | 139.03 f            | 140.2 b   | 139.61 d  | 103.98 b                    | 98.17 d   | 101.07 cd |
| 8x9       | 113.2 w               | 115.17 u   | 114.18 u  | 183.67 l-m                         | 185 z      | 185.33 q   | 125.9 k             | 126.73 ij | 126.31 k  | 83.24 o                     | 87.3 i    | 85.27 m   |
| $\bar{X}$ | 116.95                | 118.34     | 117.69    | 185.94                             | 187.56     | 186.75     | 123.79              | 122.03    | 122.91    | 86.27                       | 96.47     | 86.37     |
| r         | 0.41                  | 0.45       | 0.43      | 0.47                               | 0.125      | 0.29       | 0.69                | 0.69      | 0.69      | 0.67                        | 0.44      | 0.55      |

Mean designated by the same letter are not significant different at the 5% level according to Duncan's multiple range test.

\*and\*\* significant at 0.05 and 0.01 levels of probability, respectively.

S1, S2 and C = first, second and combined analysis, respectively. r = Correlation coefficient between mid -parent and F1 performance.

Table ( 7 ): The genotype mean performance (  $s_1$ ,  $s_2$  and C ) for all parents and crosses studied in F1 generation .

| Genotype      | Height of flag region(cm) |           |           | Flag leaf area (cm <sup>2</sup> ) |          |           | Number of tillers |           |           | Number of spikes per plant |           |           |
|---------------|---------------------------|-----------|-----------|-----------------------------------|----------|-----------|-------------------|-----------|-----------|----------------------------|-----------|-----------|
|               | $s_1$                     | $s_2$     | C         | $s_1$                             | $s_2$    | C         | $s_1$             | $s_2$     | C         | $s_1$                      | $s_2$     | C         |
| P1 (Dumata 1) | 35.43 km                  | 31.47 t-v | 33.45 q   | 49.52 q-t                         | 51.3 k   | 50.41 m-p | 20.60 p           | 24.27 hi  | 22.43 p-r | 18.73 op                   | 21.6 f-i  | 20.16 p-t |
| P2 (RCB33)    | 33.64 n                   | 32.77 q-a | 33.20 q-r | 43.77 z                           | 44.9 r   | 44.33 v   | 21.99 mm          | 28.47 b   | 25.23 p-d | 19.31 oo                   | 21.87 e-h | 20.59 m-q |
| P3 (RCB36)    | 35.11 m                   | 36 f-h    | 35.55 j-m | 50.78 m-p                         | 52.17 ij | 51.47 km  | 21.39 o           | 27.4 c    | 24.39 e-g | 18.34 p                    | 21.37 b-k | 19.85 at  |
| P4 (Subh69)   | 32.3 o                    | 31.50 t-v | 31.9 at   | 50.39 e-q                         | 50.4 km  | 50.40 e-p | 20.06 p           | 27.10 c-a | 23.58 i-a | 18.30 p                    | 22.37 e   | 20.33 o-s |
| P5 (RCB70)    | 29.3 q                    | 35.20 x   | 32.25 rs  | 49.25 r-t                         | 50.3 m   | 49.77 pq  | 22.43 k-a         | 21.63 rs  | 22.03 rs  | 19.53 mm                   | 19.60 q-r | 19.56 t   |
| P6 (RCB 122)  | 30.62 p                   | 31.43 t-v | 31.02 km  | 58.37 c                           | 60.4 b   | 59.38 c   | 17.07 s           | 21.57 rs  | 19.32 t   | 14.64 r                    | 19.23 r-t | 16.93 w   |
| P7 (RCB143)   | 39.19 h                   | 43.30 a   | 41.24 bc  | 54.85 ij                          | 56.33 ef | 55.60 h   | 20.38 p           | 29.53 a   | 24.91 e-e | 18.32 p                    | 21.53 g-i | 19.92 r-t |
| P8 (Cim 157)  | 36.95 jk                  | 35.60 g-i | 36.27 b-k | 47.88 uv                          | 50.07 m  | 48.97 rs  | 16.63 s           | 22.73 k-a | 19.68 t   | 14.94 r                    | 20.4 m-p  | 17.67     |
| P9 (Cim 146)  | 35.86 km                  | 34.10 k-o | 34.98 k-o | 43.47 z                           | 45.97 q  | 44.72 v   | 18.50 r           | 26.57 e   | 22.53 p-r | 16.96 q                    | 22.47 de  | 19.71 at  |
| 1x2           | 40.10 f-h                 | 35.17 b-j | 37.63 e-g | 49.3 r-t                          | 51.13 hi | 50.21 o-q | 19.35 q           | 24.07 hi  | 21.71 s   | 18.83 op                   | 22.3 e    | 20.56 n-q |
| 1x3           | 41.32 de                  | 34.70 i-m | 38.01 ef  | 45.49 y                           | 47.4 op  | 46.44 n   | 22.48 k-a         | 21.93 o-r | 22.2 rs   | 20.72 l                    | 21.63 f-i | 21.17 i-a |
| 1x4           | 39.56 gh                  | 36.30 g   | 37.93 ef  | 51.53 mm                          | 51.57 jk | 51.55 km  | 25.2 c            | 22.50 m-p | 23.85 g-l | 23.3 de                    | 20.6 l-a  | 21.93 e-h |
| 1x5           | 40.92 ef                  | 33.80 m-q | 37.36 e-h | 50.45 o-q                         | 52.6 hi  | 51.51 km  | 23.5 gh           | 24.57 gh  | 24.03 f-k | 21.72 hi                   | 21.13 i-l | 21.42 g-l |
| 1x6           | 26.23 s                   | 31.80 p-a | 29.01 v   | 52.87 l                           | 54.87 g  | 53.87 j   | 22.94 b-k         | 21.70 q-s | 22.32 p-a | 21.89 gh                   | 20.07 n-q | 20.98 k-o |
| 1x7           | 28.33 r                   | 39.7 c    | 34.01 n-q | 57.32 d                           | 57.53 d  | 57.42 d-f | 24.47 d-f         | 23.23 j-l | 23.85 g-l | 23.73 cd                   | 19.57 q-r | 21.63 g-j |

Mean designated by the same letter are not significant different at the 5% level according to Duncan's multiple range test.

\*and\*\* significant at 0.05 and 0.01 levels of probability, respectively.

$s_1$ ,  $s_2$  and C = first, second and combined analysis, respectively.  $r$  = Correlation coefficient between mid -parent and F1 performance.

Table ( 7 ): The genotype mean performance (  $s_1$ ,  $s_2$  and C ) for all parents and crosses studied in F1 generation .

| Genotype | Height of flag region(cm) |            |           | Flag leaf area (cm <sup>2</sup> ) |          |           | Number of tillers |           |           | Number of spikes per plant |           |           |
|----------|---------------------------|------------|-----------|-----------------------------------|----------|-----------|-------------------|-----------|-----------|----------------------------|-----------|-----------|
|          | S1                        | S2         | C         | S1                                | S2       | C         | S1                | S2        | C         | S1                         | S2        | C         |
| 1x8      | 30.22 Pq                  | 39.93 93 c | 35.07 k-o | 49.5 q-t                          | 51.23 k  | 50.36 n-p | 25.39 c           | 25.93 f   | 25.66 ab  | 24 c                       | 23.9 b    | 23.95     |
| 1x9      | 37.4 ij                   | 29 w       | 33.2 q*   | 48.71 m                           | 52.67 l  | 50.70 oo  | 25 cd             | 23 k-m    | 24 f-k    | 19.47 mn                   | 23.10 c   | 21.28 i-l |
| 2x3      | 45.97 b                   | 41.90 b    | 43.91 a   | 56.16 f-h                         | 57.17 d  | 56.66 g   | 24.79 cd          | 20.40 t   | 22.59 p-r | 22.08 gh                   | 17.30 v   | 19.69 m   |
| 2x4      | 40.57 e-g                 | 33.77 m-q  | 37.17 f-i | 49.48 r-t                         | 49.73 m  | 49.60 pr  | 24.36 de          | 24.7 gh   | 24.63 d-f | 22.07 gh                   | 23.23 c   | 22.65 c   |
| 2x5      | 27.74 r                   | 25.5 b-k   | 26.62 w   | 55.31 l                           | 56.23 ef | 55.77 h   | 24.83 cd          | 27.27 cd  | 26.05 u   | 23.33 de                   | 24.77 a   | 24.05 a   |
| 2x6      | 35.05 m                   | 25.8 y     | 30.42 u   | 53.11                             | 54.63 g  | 53.86 j   | 24 e-g            | 23.07 km  | 23.33 j-n | 22.96 ef                   | 22.2 ef   | 22.58 c-e |
| 2x7      | 42.29 cd                  | 37.37 de   | 39.83 d   | 55.76 g-i                         | 58.33 c  | 57.04 e-g | 23.96 e-g         | 23.83 ig  | 23.89 g-l | 23.21 de                   | 22.03 e-g | 22.62 cd  |
| 2x8      | 36.61 gh                  | 35.17 b-j  | 35.89 i-l | 58.45 c                           | 51.20 k  | 54.82 j   | 26 p              | 25.13 g   | 25.56 m-e | 22.40 fg                   | 23.03 c   | 22.71 c   |
| 2x9      | 34.9 m                    | 32.87 p-r  | 33.88 p-q | 45.86 xy                          | 47.03 p  | 46.44 u   | 25 cd             | 20.37 t   | 22.68 o-r | 19.08 no                   | 18.83 tu  | 18.95 u   |
| 3x4      | 37.5 ij                   | 31.07 uv   | 34.28 n-q | 56.33 f-g                         | 56.73 de | 56.59 g   | 23.25 b-j         | 22.73 k-n | 22.99 m-p | 21.46 h-k                  | 19.57 qr  | 20.51 m-r |
| 3x5      | 36.27 kl                  | 33.43 n-q  | 34.85 l-p | 56.75 d-f                         | 58.33 c  | 57.64 de  | 24.94 cd          | 23.37 jk  | 24.15 f-j | 24 c                       | 20.8 k-m  | 22.4 c-e  |
| 3x6      | 35.21 m                   | 36.57 e-q  | 35.89 j-k | 54.21 jk                          | 54.97 g  | 54.59 ig  | 23.5 gh           | 25.10 g   | 24.3 f-h  | 22.92 ef                   | 23.03 cd  | 22.97 bc  |
| 3x7      | 42.07 cd                  | 33.87 m-p  | 37.97 ef  | 53.62 kl                          | 55.73 f  | 54.68 i   | 22.71 j-l         | 22.57 l-o | 22.64 p-r | 20.74 i                    | 18.9 e-u  | 19.82 m   |
| 3x8      | 35.25 m                   | 36.7 ef    | 35.97     | 56.01 f-h                         | 57.30 d  | 56.66 g   | 23.89 g           | 26.93 c-e | 25.41 bc  | 22.41 g                    | 24.23 ab  | 23.32 b   |
| 3x9      | 34.59 m                   | 37.9 d     | 36.24 b-k | 46.67 wx                          | 48.07 no | 47.37 t   | 22.2 l-a          | 22.37 m-q | 22.28 q-s | 20.87 kl                   | 21.4 s-j  | 21.13 i-n |
| 4x5      | 36.71 jk                  | 35.2 d     | 35.95 i-l | 52.17 i                           | 52.63 l  | 52.67 k   | 22.57 k-m         | 24.17 li  | 23.37 k-n | 20.92 j-l                  | 20.83 j-m | 20.87 l-o |

Mean designated by the same letter are not significant different at the 5% level according to Duncan's multiple range test.

\*and\*\* significant at 0.05 and 0.01 levels of probability, respectively.

S1, S2 and C = first, second and combined analysis, respectively. r = Correlation coefficient between mid -parent and F1 performance.

Table ( 7 ): The genotype mean performance (  $S_1$ ,  $S_2$  and C ) for all parents and crosses studied in F1 generation

| Genotype  | Height of flag region(cm) |           |           | Flag leaf area (cm <sup>2</sup> ) |          |          | Number of tillers |           |           | Number of spikes per plant |           |           |
|-----------|---------------------------|-----------|-----------|-----------------------------------|----------|----------|-------------------|-----------|-----------|----------------------------|-----------|-----------|
|           | S1                        | S2        | C         | S1                                | S2       | C        | S1                | S2        | C         | S1                         | S2        | C         |
| 4x6       | 38.13 i                   | 32.23 r-t | 35.18 k-a | 47.55 vw                          | 49.63 m  | 48.59 a  | 22.99 b-k         | 21.77 q-s | 22.38 p-r | 21 j-l                     | 20.57 l-o | 20.78 i-p |
| 4x7       | 40.44 o-g                 | 39.83 c   | 40.13 cd  | 49.17 r-t                         | 51.33 k  | 50.23    | 23 b-k            | 21.10 s   | 22.05 m   | 21.33 b-k                  | 20 o-q    | 20.76 l-p |
| 4x8       | 51.03 a                   | 35.7 b-l  | 43.36 a   | 49.85 p-a                         | 52.3 ij  | 51.08 mn | 28.42 a           | 20.07 t   | 24.24 f-i | 26 a                       | 18.7 tu   | 22.35 c-f |
| 4x9       | 32.77 mo                  | 34.2 j-o  | 33.48 q   | 50.09 p-r                         | 53.4 h   | 51.73 km | 25 cd             | 22.03 w   | 23.51 j-n | 19.61 mn                   | 19.87 p-q | 19.74 st  |
| 5x6       | 39.24 h                   | 34 l-o    | 36.62 g-j | 58.7 c                            | 60.3 b   | 59.5 c   | 22.79 il          | 24.47 g-i | 23.63 b-m | 21.58 b-j                  | 21.93 e-h | 21.75 f-i |
| 5x7       | 36.7 jk                   | 39.83 c   | 38.26 ef  | 51.73 m                           | 52.4 i   | 52.07 kl | 21.33 o           | 24.57 gh  | 22.95 n-q | 20.67 l                    | 22.43 e   | 21.55 g-k |
| 5x8       | 39.62 gh                  | 36 f-h    | 37.81 eg  | 46.8 wx                           | 47.83 o  | 47.32 t  | 25.36 c           | 21.83 p-r | 23.59 i-n | 24.81 b                    | 18.5 u    | 21.65 g-j |
| 5x9       | 33.35 n                   | 33.83 m-q | 33.69 pq  | 51.35 m-o                         | 53.03 hi | 52.19 kl | 23.40 g-i         | 21.83 p-r | 22.61 p-r | 21.17 i-j                  | 18.97 s-u | 20.07 q-t |
| 6x7       | 42.71 c                   | 33.20 o-r | 37.95 ef  | 60.34 b                           | 60.77 b  | 60.56 b  | 23.06 b-k         | 24.1 hi   | 23.58 i-n | 22.8 ef                    | 21.97 e-h | 22.38 c-e |
| 6x8       | 42.17 cd                  | 38.4 v    | 40.28 cd  | 48.99 st                          | 49.97 m  | 49.48 qv | 24.17 ef          | 24.67 gh  | 24.42 e-g | 21.71 hi                   | 60.34 b   | 22 d-g    |
| 6x9       | 32.33 o                   | 36.63 o-g | 34.48 m-q | 57.14 de                          | 58.97 c  | 58.06 d  | 25 cd             | 21.60 rs  | 23.3 i-o  | 23 ef                      | 48.99 st  | 21.23 i-m |
| 7x8       | 40.57 o-g                 | 43.07 a   | 41.8 b    | 50.68 n-p                         | 52.8 hi  | 51.74 km | 24 e-g            | 28.33 b   | 26.16 a   | 23.27 de                   | 23.03 cd  | 23.15 i-n |
| 7x9       | 35.04 m                   | 42.03 b   | 38.53 o   | 46.10 xy                          | 48.73 a  | 47.42 t  | 22.8 i-l          | 22.2 s-r  | 22.5 p-r  | 22 gh                      | 20.67 lm  | 21.33 b-l |
| 8x9       | 42.66 c                   | 37.43 de  | 40.04 d   | 61.44 a                           | 62.63 a  | 62.04 a  | 21.93 a           | 26.6 de   | 24.26 f-i | 20.07 m                    | 21.9 e-h  | 20.98 j-o |
| $\bar{X}$ | 37.34                     | 35.38     | 36.46     | 52.38                             | 53.72    | 53.05    | 23.82             | 23.45     | 23.63     | 21.98                      | 21.19     | 21.58     |
| r         | 37.54                     | 0.27      | 0.20      | 0.17                              | 0.30     | 0.23     | -0.26             | 0.22      | -0.02     | 0.09                       | 0.09      | 0.09      |

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\* and \*\* significant at 0.05 and 0.01 levels of probability, respectively.

r = Correlation coefficient between mid -parent and F1 performance  
S1, S2 and C = first, second and combined analysis, respectively.

Table ( 7 ): The genotype mean performance ( S<sub>1</sub>, S<sub>2</sub> and C ) for all parents and crosses studied in F1 generation .

| Genotype      | Spike length ( cm ) |          |          | Number of spikelets per spike |          |           | Number of grains per spike |           |           | 1000 - Kernel weight (g) |           |           |
|---------------|---------------------|----------|----------|-------------------------------|----------|-----------|----------------------------|-----------|-----------|--------------------------|-----------|-----------|
|               | S1                  | S2       | C        | S1                            | S2       | C         | S1                         | S2        | C         | S1                       | S2        | C         |
| P1 (Gemma 1)  | 13.97 t             | 12.33 x  | 13.15 pq | 24.31 mm                      | 22.47 a  | 23.40 r-t | 70.43 f                    | 70.00 r   | 70.21 pq  | 64.31 p-s                | 57.97 v   | 61.14 u   |
| P2 (RCB33)    | 14.63 mo            | 12.73 a  | 13.68 mm | 24.87 p-i                     | 22.62 m  | 23.00     | 60.93 fl                   | 74.93 op  | 69.93 pq  | 66.23 k-m                | 63.87 m-p | 63.05 k-o |
| P3 (RCB56)    | 14.87 km            | 13.30 mo | 14.08 ij | 24.03 p-r                     | 23.37 i  | 23.70 op  | 74.83 d                    | 78.97 kl  | 76.90 d   | 64.17 p-s                | 64.33 j-a | 64.25 n-q |
| P4 (Saba 49)  | 12.43 x             | 11.77 z  | 12.10 i  | 23.06 t                       | 22.17 o  | 22.61 u   | 80.75 b                    | 63.83 t   | 72.30 k-n | 64.26 p-s                | 63 o-q    | 63.71 q   |
| P5 (RCB70)    | 12.83 w             | 13.73 ij | 13.28 p  | 22.836 u                      | 23.97 f  | 23.40 r-t | 80.44 b                    | 88.47 bc  | 84.45 a   | 61.31 t                  | 33.17 w   | 57.34 v   |
| P6 (RCB122)   | 14.26 rs            | 13.0 st  | 13.63 n  | 23.88 q                       | 21.93 pq | 22.40 v   | 81.33 b                    | 77 m      | 79.16 bc  | 63.71 m                  | 64.87 b-m | 64.29 n-q |
| P7 (RCB143)   | 13.43 v             | 11.7 z   | 12.56 s  | 24.67                         | 23.17 j  | 23.92 l-n | 80.5 b                     | 68.63 s   | 74.56 q   | 63.58 m                  | 60.73 t   | 62.15 st  |
| P8 (Gizal 57) | 14.2 s              | 11.93 yz | 13.06 q  | 24.64 k                       | 22.03 p  | 23.33 st  | 75.43 cd                   | 67.93 s   | 71.68 l-o | 63.67 m                  | 64.7 m    | 64.18 n-q |
| P9 (Gizal 64) | 13.69 u             | 11.83 z  | 12.76 r  | 24.0 p-r                      | 22.6 mm  | 23.30 t   | 83.07 a                    | 72.77 q   | 77.92 cd  | 67.67 b-j                | 62.17 m   | 64.92 l-o |
| Ix2           | 14.34 q-t           | 11.97 y  | 13.15 pq | 24.12 p-p                     | 22.50 n  | 23.31 t   | 82.87 a                    | 76.07 m-o | 79.47 b   | 63.79 m                  | 69.87 e   | 66.83 d-i |
| Ix3           | 14.62 n-p           | 13.53 k  | 14.07 ij | 23.86 r                       | 23.33 l  | 23.59 pq  | 75.39 cd                   | 83.97 e   | 79.68 b   | 70.17 a-d                | 64 k-o    | 67.08 d-h |
| Ix4           | 14.5 o-q            | 12.53 vw | 13.51 mo | 24.07 o-q                     | 22.93 k  | 23.5 q-s  | 60.47 l                    | 75.83 m-o | 68.15 s   | 63.06 n-p                | 64.87 b-m | 64.96 w   |
| Ix5           | 15.12 i-k           | 13.1 yz  | 14.11 ij | 24.84 b-j                     | 23.3 ij  | 24.07 kl  | 65.43 j                    | 76.7 mm   | 71.06 n-q | 64.76 o-r                | 65.50 f-i | 65.13 k-o |
| Ix6           | 14.88 km            | 14.83 s  | 14.83 bc | 23.68 s                       | 23.9 f   | 23.79 m-o | 70.07 fg                   | 78.4 l    | 74.24 e-h | 70.76 ab                 | 62.17 q-s | 66.46 o-i |

Mean designated by the same letter are not significant different at the 5% level according to Duncan's multiple range test.

\*and\*\* significant at 0.05 and 0.01 levels of probability, respectively.

S1, S2 and C = first, second and combined analysis, respectively.

r = Correlation coefficient between mid -parent and F1 performance

Table ( 7 ) : The genotype mean performance (  $s_1$ ,  $s_2$  and C ) for all parents and crosses studied in F1 generation .

| Genotype | Spike length ( cm ) |           |           | Number of spikelets per spike |          |           | Number of grains per spike |           |           | 1000 - Kernel weight (g) |          |          |
|----------|---------------------|-----------|-----------|-------------------------------|----------|-----------|----------------------------|-----------|-----------|--------------------------|----------|----------|
|          | S1                  | S2        | C         | S1                            | S2       | C         | S1                         | S2        | C         | S1                       | S2       | C        |
| 1x7      | 15.47 gh            | 12.97 i   | 14.22 hi  | 25.08 ef                      | 23.57 gh | 24.33 ij  | 65.2 j                     | 80.73 b-j | 72.97 b-i | 71.15a                   | 69.87e   | 66.83d-i |
| 1x8      | 14.96 j-l           | 14.07 cd  | 14.31 ef  | 25.42 cd                      | 24.7 e   | 25.06 cd  | 69.47 f-h                  | 81.5 gh   | 75.49 e   | 63.43e                   | 64ko     | 67.08d-h |
| 1x9      | 15.88 c             | 12.8 u    | 14.34 f-h | 24 pr                         | 22.7 lm  | 23.35 ef  | 73.5 o                     | 74.4 p    | 73.95 f-i | 64.61o-a                 | 64.87h-m | 64.96w   |
| 2x3      | 15.75 c-f           | 13.77 b-j | 14.76     | 25.64 b                       | 23.93 f  | 24.79 ef  | 65.53 j                    | 76.87 m   | 71.2 m-p  | 67.68b-j                 | 65.50f-i | 65.13k-o |
| 2x4      | 14.25 rs            | 11.90 xx  | 13.07 q   | 23.98 pr                      | 22.87 k  | 23.43 qf  | 67.94 i                    | 69.07 n   | 68.51 n   | 46.36p-a                 | 62.17q-s | 66.46e-i |
| 2x5      | 15.33 hi            | 14.17 c   | 14.75 b-d | 24.83 b-j                     | 24.67 e  | 24.75 ef  | 75.43 cd                   | 78.87 hi  | 77.15 d   | 63.82rs                  | 68.17bc  | 69.66a   |
| 2x6      | 15.82 c-o           | 13.97 d-f | 14.90 b   | 25.45 c                       | 23.27 ij | 24.36 i   | 60.43 l                    | 83.2 ef   | 71.82 l-n | 69.41c-f                 | 65.07g-j | 64.25n-q |
| 2x7      | 15.68 c-g           | 13.53 k   | 14.60 de  | 25.67 b                       | 23.7 g   | 24.69 pg  | 60.93 l                    | 81.03 hi  | 70.98 n-q | 70.09e-d                 | 67.37cd  | 65.99i-l |
| 2x8      | 15.65 d-g           | 13.87 f-h | 14.76 b-d | 24.26 m-o                     | 23.4 i   | 23.83 m-o | 64.57 j                    | 80.47 b-j | 72.52 e   | 67.96g-i                 | 58.97u   | 63.32qf  |
| 2x9      | 16.13 p             | 14.03 de  | 15.08 a   | 24 p-r                        | 24.9 d   | 24.45 hi  | 68.93 g-i                  | 88.7 b    | 78.82 bc  | 68.92a-g                 | 60.60r   | 62.48rs  |
| 3x4      | 15.85 cd            | 13.40 l-n | 14.63 de  | 25.39 cd                      | 24.97 d  | 25.18 c   | 76.23 cd                   | 81.77 gh  | 79 bc     | 63.69rs                  | 58.17wv  | 60.99u   |
| 3x5      | 15.33 hi            | 13.50 hi  | 14.42 fg  | 25.79 ab                      | 23.73 g  | 24.76 ef  | 60.63 l                    | 80.07 j-k | 70.35 o-q | 65.62m-o                 | 67.43cd  | 68.42bc  |
| 3x6      | 14.75 mn            | 13.73 ij  | 14.23 hi  | 24.92 f-h                     | 23.43 gh | 24.18 jk  | 60.47 l                    | 79.97 i-k | 70.22 pq  | 69.93b-e                 | 67.73cd  | 68.91ab  |
| 3x7      | 15.82 c-o           | 14.47 b   | 15.15 a   | 25.90 a                       | 23.30 c  | 25.6 b    | 62.73 k                    | 83.27 ef  | 73 b-l    | 65.01n-q                 | 63.90l-p | 65.94i-l |
| 3x8      | 15.47 gh            | 13.90 fg  | 14.69 cd  | 24.26 m-o                     | 23.57 gh | 23.91 a   | 65.77 j                    | 93.47 a   | 75.12 ef  | 65.63m-o                 | 65.83f-h | 67.37c-f |
| 3x9      | 14.39 j-m           | 13.23 o-q | 13.81 lm  | 25.03 fg                      | 23.70 g  | 24.37 hi  | 65.6 j                     | 79.43 j-l | 72.51 j-m | 69.62b-f                 | 68.23bc  | 65.96i-l |
| 4x5      | 14.92 k-m           | 13.27 op  | 14.09 ij  | 25.44 cd                      | 23.63 g  | 24.54 gh  | 60.93 l                    | 75.73 m-p | 68.33 s   | 65.93l-n                 | 62.50q-a | 62.61rs  |

Mean designated by the same letter are not significant different at the 5% level according to Duncan's multiple range test.

\*and\*\* significant at 0.05 and 0.01 levels of probability, respectively.

S1, S2 and C = first, second and combined analysis, respectively.  $r$  = Correlation coefficient between mid-parent and F1 performance

Table ( 7 ): The genotype mean performance (  $s_1$ ,  $s_2$  and C ) for all parents and crosses studied in F1 generation .

| Genotype  | Spiko length ( cm ) |           |           | Number of spikelets per spike |          |           | Number of grains per spike |           |           | 1000 - Kernel weight (g) |           |           |
|-----------|---------------------|-----------|-----------|-------------------------------|----------|-----------|----------------------------|-----------|-----------|--------------------------|-----------|-----------|
|           | S1                  | S2        | C         | S1                            | S2       | C         | S1                         | S2        | C         | S1                       | S2        | C         |
|           |                     |           |           |                               |          |           |                            |           |           |                          |           |           |
| 4x6       | 14.89 k-m           | 13.13 rj  | 14.01 jk  | 24.83 b-j                     | 23.4 bc  | 25.12 c   | 76.37 c                    | 78.67 kl  | 77.32 d   | 66.73 j-l                | 63.13 o-r | 64.94 l-o |
| 4x7       | 15.16 ij            | 13.77 b-j | 14.47 o-g | 25.40 cd                      | 23.67 g  | 24.54 gh  | 68.09 i                    | 74.37 p   | 71.2 mnp  | 63.77 m                  | 66.03 fg  | 64.90 l-p |
| 4x8       | 15.61 eg            | 13.44     | 14.31 gh  | 24.07 o-q                     | 22.83 kl | 23.45 q-t | 55.17 m                    | 75.43 n-p | 65.3 t    | 66.19 k-m                | 62.10 s   | 64.14 o-p |
| 4x9       | 15.54 f-h           | 12.57 v   | 14.06 ij  | 24. p-r                       | 22.93 k  | 23.47 q-t | 70.63 f                    | 75.93 m-o | 73.28 g-k | 67.76 b-j                | 64.77 i-m | 66.26 g-j |
| 5x6       | 14.98 j-l           | 13.17 p-r | 14.08 ij  | 24.37 km                      | 23.47 b  | 24.92 de  | 70.63 f                    | 80.10 i-k | 75.05 ef  | 67.21 i-k                | 64.57 i-m | 65.89 i-m |
| 5x7       | 15.08 j-l           | 13.33 m-o | 14.21 kl  | 24.09 op                      | 23.63 g  | 23.96 m-o | 68.47 kl                   | 79.07 kl  | 73.77 fj  | 67.93 g-i                | 67.1 de   | 67.51 c-e |
| 5x8       | 14.43 o-r           | 13.77 b-j | 14.1 ij   | 24.76 b-j                     | 23.37 i  | 24.07 kl  | 60.53 i                    | 87.10 d   | 73.91 fj  | 70.44 n-c                | 63.77 n-o | 67.10 d-h |
| 5x9       | 14.93 k-m           | 13.80 p-i | 14.37 f-h | 24.3 kl                       | 23.4 i   | 23.95 km  | 65 j                       | 83.37 ef  | 74.18 e-h | 61.34 t                  | 66.30 ef  | 63.82 pq  |
| 6x7       | 14.41 p-s           | 12.50 vw  | 13.46 o   | 24.81 bj                      | 23.3 ij  | 24.06 kl  | 65.7 j                     | 74.4 p    | 70.05 pq  | 69.21 d-f                | 67.60 cd  | 68.40 bc  |
| 6x8       | 13.75 u             | 13.43 k-m | 13.59 mo  | 23.63 n                       | 21.83 q  | 22.73 u   | 68.67 g-i                  | 87.33 cd  | 78 cd     | 66.92 i-l                | 63.83 fh  | 66.37 fj  |
| 6x9       | 15.02 j-l           | 13.67 j   | 14.35 f-h | 24.23 m-o                     | 23.43 kl | 23.83 m-o | 75.23 cd                   | 83.2 ef   | 79.2 bc   | 70.11 e-d                | 62.23 q-s | 64.82 m-p |
| 7x8       | 14.27 re            | 13.47 kl  | 13.87 kl  | 24.74 b-j                     | 24.90 d  | 24.82 ef  | 63.10 k                    | 82.43 fg  | 72.76 i-l | 67.42 i-j                | 62.93 p-s | 65.78 i-m |
| 7x9       | 14.88 km            | 12.42 wx  | 13.66 mm  | 24.15 n-p                     | 22.93 k  | 23.54 p-r | 60.70 l                    | 78.67 kl  | 69.68 q   | 68.63 f-h                | 58.87 uv  | 61.38 tu  |
| 8x9       | 15.02 j-l           | 13.93 ef  | 14.48 e-g | 25.25 de                      | 23.73 g  | 24.49 kl  | 83.63 a                    | 76.2 m-o  | 79.91 b   | 63.89 q-s                | 64.88     | 65.90     |
| $\bar{X}$ | 15.08               | 13.40     | 14.24     | 24.68                         | 23.68    | 24.18     | 67.49                      | 79.80     | 73.64     | 66.91                    | 64.88     | 0.07      |
| r         | 0.09                | 0.28      | 0.18      | 0.015                         | 0.23     | 0.12      | -0.08                      | 0.26      | 0.09      | 0.05                     | 0.098     |           |

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S1, S2 and C = first, second and combined analysis, respectively. r = Correlation coefficient between mid -parent and F1 performance

Table ( 7 ) : The genotype mean performance (  $s_1$ ,  $s_2$  and C ) for all parents and crosses studied in F1 generation .

| Genotype      | Grain yield per plant (g) |           |           | Straw yield per plant (g) |          |           | Harves index |         |         | Total plant weight (g) |            |            |
|---------------|---------------------------|-----------|-----------|---------------------------|----------|-----------|--------------|---------|---------|------------------------|------------|------------|
|               | S1                        | S2        | C         | S1                        | S2       | C         | S1           | S2      | C       | S1                     | S2         | C          |
| P1 (Gemma 1)  | 78.83 t                   | 79.30 z   | 79.06 t   | 64.23 v                   | 64.33 ij | 64.28 u   | 0.55 ef      | 0.55 at | 0.55 ij | 143.06 w               | 149.63 o   | 146.34 v   |
| P2 (RCB33)    | 99 h                      | 96.33 n-o | 97.66 g-k | 54.33 w                   | 50.67 q  | 52.50 w   | 0.65 a       | 0.65 ij | 0.65 ab | 133.33 v               | 152.9 n    | 153.11 u   |
| P3 (RCB56)    | 118.34 b                  | 100.5 ij  | 109.42    | 88.32 m                   | 71.57 fg | 79.94 k-m | 0.57 d       | 0.58 pq | 0.57 gh | 206.66 g               | 172.07 c-e | 189.36 de  |
| P4 (Sabb69)   | 94.09 k                   | 82.03 z   | 88.06 q   | 86.74 s                   | 73.13 e  | 80.93 kl  | 0.52 hi      | 0.52 u  | 0.52 lm | 180.83 at              | 137.17 j-l | 169 q      |
| P5 (RCB70)    | 125.2 a                   | 84.5 y    | 104.85 de | 73.71 u                   | 38.77 wv | 56.24 v   | .63 b        | 0.67 gh | 0.65 ab | 198.91 j-l             | 123.33 t   | 161.12 t   |
| P6 (RCB 122)  | 103.67 fg                 | 87.47 z   | 93.57 kl  | 72.61 u                   | 57.13 mo | 64.87 u   | 0.59 c       | 0.60 no | 0.59 ef | 176.4 u                | 144.6 pq   | 160.5 t    |
| P7 (RCB143)   | 98.33 h                   | 81.97 z   | 90.15 o-q | 87.48 n                   | 81.03 cd | 84.25 hi  | 0.53 gh      | 0.50 v  | 0.52 lm | 185.81 q               | 156.33 lm  | 171.07 o-q |
| P8 (Clea 157) | 90.31 l-m                 | 80.50 z   | 85.4 s    | 94.24 q                   | 79.83 d  | 87.03 fg  | 0.49 j       | 0.50 v  | 0.49 op | 184.55 q               | 160.33 ij  | 172.44 op  |
| P9 (Clea 146) | 106.56 o                  | 91.90 r-t | 99.23 g   | 80.83 t                   | 73.10 ef | 76.96 o   | 0.57 de      | 0.56 rs | 0.56 hi | 187.39 pq              | 166.8 gh   | 177.09 k-m |
| 1x2           | 86.84 op                  | 110.17 e  | 98.5 gh   | 107.73 hi                 | 45.67 n  | 76.7 o    | 0.45 no      | 0.71 ef | 0.58 fg | 194.57 no              | 155.83 l-n | 175.2 mn   |
| 1x3           | 103.33 g                  | 107.43 f  | 105.38 d  | 90.1 r                    | 37.40 v  | 63.75 n   | 0.55 fg      | 0.74 c  | 0.64 b  | 192.43 o               | 144.83 pq  | 169.13 q   |
| 1x4           | 90.36 l-m                 | 92.37 t   | 91.36 n-p | 111.01 b-j                | 44.23 n  | 77.62 no  | 0.45 no      | 0.68 g  | 0.56 hi | 201.11 i-k             | 136.6 rs   | 168.85 q   |
| 1x5           | 78.47 t                   | 97.30 mn  | 87.88 q   | 106.14 km                 | 82.2 c   | 94.17 c   | 0.42 pq      | 0.54 t  | 0.48 pq | 186.68 pq              | 179.5 a    | 183.09 j   |
| 1x6           | 103.75 fg                 | 88.73 wx  | 93.99 i-l | 128.83 a                  | 59.90 km | 94.36 c   | 0.44 no      | 0.6 no  | 0.52 lm | 232.33 c               | 147.8 o    | 190.06 d   |
| 1x7           | 9302i-l                   | 99.6jk    | 96.41b-l  | 109.59 i-k                | 58.07 mn | 83.83 b-j | 0.46 mn      | 0.63 kl | 0.54 jk | 202.62 hi              | 157.87 j-l | 180.24 j   |
| 1x9           | 91.96j-l                  | 118.2c    | 105.08 d  | 113.59 gh                 | 50.3 q   | 81.94 i-k | 0.45 no      | 0.7 f   | 0.57 gh | 205.55 g               | 168.5 f-g  | 187.02 e-h |

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Table ( 7 ) : The genotype mean performance (  $S_1$ ,  $S_2$  and C ) for all parents and crosses studied in F1 generation .

| Genotype | Grain yield per plant( g ) |            |           | Straw yield per plant ( g ) |         |          | Harvest index % |         |         | Total plant weight ( g ) |            |            |
|----------|----------------------------|------------|-----------|-----------------------------|---------|----------|-----------------|---------|---------|--------------------------|------------|------------|
|          | S1                         | S2         | C         | S1                          | S2      | C        | S1              | S2      | C       | S1                       | S2         | C          |
| 2X3      | 84.94 pq                   | 107.8 f    | 96.37 b-l | 103.92m-o                   | 56.97no | 80.44k-m | 0.45mn          | 0.63ij  | 0.55ij  | 188.92p                  | 157.77j-l  | 173.34no   |
| 2X4      | 87.06 op                   | 70.43 z    | 78.74 t   | 108.76ik                    | 87.10a  | 79.93k-n | 0.44na          | 45w     | 0.44r   | 195.83m-o                | 157.53j-l  | 178.68lm   |
| 2X5      | 85.44 pq                   | 93.97 q-s  | 89.7 p-q  | 119.06cd                    | 71.07fg | 95.06bc  | 0.42 a          | 0.57 q* | 0.49 op | 204.44 gh                | 165.03 h   | 184.73 bi  |
| 2X6      | 106.41 g                   | 105.73 g   | 106.07 d  | 113.58gh                    | 68.42h  | 91d      | 0.48jk          | 0.61 mn | 0.54 jk | 220 e                    | 171.17 d-f | 195.58 c   |
| 2X7      | 106.66 e                   | 116.90 c   | 111.78 b  | 103.94m-o                   | 31.50w  | 67.72i   | 0.53 bi         | 0.79 b  | 0.66 a  | 202.5 bi                 | 148.4 o    | 175.45 mn  |
| 2X8      | 92.91 i-l                  | 112.57 d   | 102.74 ef | 118.13de                    | 26.33x  | 72.23pq  | 0.44 no         | 0.81 a  | 0.62 c  | 211.25 f                 | 138.9 r    | 175.07 mn  |
| 2X9      | 91.38 j-m                  | 111.87 d   | 101.62 f  | 109.61i-k                   | 62.60jk | 86.10f-h | 0.46 lm         | 0.64 jk | 0.55 ij | 201 i-k                  | 174.47 bc  | 187.73 d-g |
| 3X4      | 87.51 n-p                  | 101.10 b-j | 94.3 lm   | 92.51q                      | 54.63p  | 73.57p   | 0.49 d          | 0.65 ij | 0.57 gh | 180.02 t                 | 155.73 l-n | 167.87 r   |
| 3X5      | 94.04 i-k                  | 100.37 ij  | 97.2 g-k  | 115.77e-g                   | 61.1kl  | 88.43ef  | 0.44 no         | 0.62 lm | 0.53 kl | 210 f                    | 161.47 i   | 185.72 gh  |
| 3X6      | 92. j-l                    | 96.73 m-o  | 94.36 lm  | 104.66mn                    | 59.8lm  | 82.23i-k | 0.47 kl         | 0.62 lm | 0.54 jk | 196.66 l-m               | 156.53 k-m | 176.59 lm  |
| 3X7      | 99.74 h                    | 111.33 de  | 105.53 d  | 93.25q                      | 48.3r   | 70.77q-s | 0.51 i          | 0.7 f   | 0.60 de | 193.33 o                 | 159.63 i-k | 176.48 lm  |
| 3X8      | 81.85 rs                   | 95.33 o-q  | 88.59 q   | 116.8d-f                    | 58.5mn  | 87.65fg  | 0.41 q          | 0.62 lm | 0.51 mn | 198.66 j-m               | 153.83 mn  | 176.24 lm  |
| 3X9      | 88.84 m-o                  | 124.5 a    | 106.67 d  | 111.52hi                    | 51.07q  | 81.29k   | 0.44 no         | 0.71 ef | 0.57 gh | 200.37 i-k               | 175.57 b   | 187.97 d-g |
| 4X5      | 82.59 q-s                  | 102.13 h   | 92.36 m-o | 102.4b-p                    | 40.07tu | 71.23qr  | 0.45 no         | 0.72 de | 0.58 fg | 185 q*                   | 142.2 q    | 163.6 s    |
| 4X6      | 82.74 qr                   | 101.8 hi   | 92.27 m-o | 109.59p                     | 55.73op | 78.16m-o | 0.45 mn         | 0.64 jk | 0.54 jk | 183.33 rs                | 157.53 j-l | 170.43 pq  |
| 4X7      | 115.91bc                   | 93.57st    | 104.74de  | 129.08a                     | 65.07i  | 97.07b   | 0.47 kl         | 0.59 op | 0.53 kl | 245 a                    | 158.63 i-l | 201.81 b   |
| 4X8      | 88.76m-o                   | 90.73u     | 89.74pq   | 109.57i-k                   | 70.53y  | 90.05    | 0.45mo          | 0.56rs  | 0.50no  | 198.33 k-m               | 161.27i    | 179.8j     |

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S1, S2 and C = first, second and combined analysis, respectively. r = Correlation coefficient between mid -parent and F1 performance.

Table ( 7 ): The genotype mean performance ( S<sub>1</sub>, S<sub>2</sub> and C ) for all parents and crosses studied in F1 generation .

| Genotype  | Grain yield per plant( g) |           |           | Straw yield per plant ( g) |          |           | Harvest Index % |         |         | Total plant weight ( g) |            |            |
|-----------|---------------------------|-----------|-----------|----------------------------|----------|-----------|-----------------|---------|---------|-------------------------|------------|------------|
|           | S1                        | S2        | C         | S1                         | S2       | C         | S1              | S2      | C       | S1                      | S2         | C          |
| 4X9       | 99.44 h                   | 79.20 z   | 89.32 pq  | 120.89 bc                  | 44.2 s   | 82.54 i-k | 0.45 mn         | 0.64 jk | 0.54 jk | 220.33 e                | 138.4 r    | 179.36 jk  |
| 5X6       | 83.17 qr                  | 89.10 vw  | 86.13 rs  | 92.69 q                    | 45.17 s  | 68.93 r-t | 0.47 kl         | 0.66 hi | 0.56 hi | 175.86 u                | 134.27 s   | 155.06 u   |
| 5X7       | 91.18 k-m                 | 105.17 g  | 98.17 g-j | 107.81 kl                  | 55 op    | 81.4 jk   | 0.44 op         | 0.66 x  | 0.55 ij | 199 j-l                 | 158.17 j-l | 178.58 j-l |
| 5X8       | 95.21 i                   | 90.33 uv  | 92.77 mn  | 104.78 mn                  | 82.83 bc | 93.8 c    | 0.47 kl         | 0.52 u  | 0.49 op | 200 j-k                 | 173.17 b-d | 186.58 f-h |
| 5X9       | 98 h                      | 97.07 mn  | 97.53 g-k | 111.44 hi                  | 49.93 qr | 80.68 k-m | 0.46 lm         | 0.66 hi | 0.56 hi | 209.44 f                | 147 op     | 178.22 j-l |
| 6X7       | 79.83 st                  | 111.62 d  | 95.73 j-l | 105.17 m                   | 31.80 w  | 68.48 st  | 0.43 op         | 0.78 b  | 0.6 de  | 185 qr                  | 143.43 q   | 164.21 s   |
| 6X8       | 94.38 ij                  | 102.4 h   | 98.39 g-i | 115.78 eg                  | 41.50 t  | 78.64 l-o | 0.45 mn         | 0.71 ef | 0.58 fg | 210 f                   | 143.90 q   | 176.95 k-m |
| 6X9       | 93.24 i-l                 | 95.07 p-r | 94.15 lm  | 101.76 op                  | 69.63 gh | 83.69 gh  | 0.48 jk         | 0.57 qr | 0.52 lm | 195 no                  | 164.80 h   | 179.9 j    |
| 7X8       | 112.05 d                  | 121.63 b  | 116.84 a  | 115.61 e-g                 | 44.57 s  | 80.09 k-n | 0.49 j          | 0.73 cd | 0.61 cd | 227.66 d                | 166.20 gh  | 196.93 c   |
| 7X9       | 93.67 i-k                 | 98.03 lm  | 95.85 j-l | 114.66 mn                  | 81.87 cd | 93.26 c   | 0.47 kl         | 0.55 st | 0.51 mn | 198.33 k-m              | 179.90 a   | 189.11 d-f |
| 8X9       | 87.31 op                  | 90.93 u   | 89.12 pq  | 114.41 fg                  | 84.47 b  | 99.44 a   | 0.43 op         | 0.52 u  | 0.47 q  | 201.72 b-j              | 173.40 b   | 188.56 d-f |
| (45)      | 115.24 c                  | 98.73 kl  | 106.98 d  | 123.08 b                   | 71.23 fg | 97.15 b   | 0.48 jk         | 0.58 pq | 0.53 kl | 238.33 b                | 169.97 ef  | 204.15 a   |
| $\bar{x}$ | 93.31                     | 100.87    | 97.09     | 109.34                     | 56.91    | 83.12     | 0.46            | 0.64    | 0.55    | 202.54                  | 157.62     | 180.08     |
| r         | -0.09                     | 0.14      | 0.025     | 0.12                       | 0.008    | 0.06      | 0.17            | 0.128   | 0.15    | 0.11                    | -0.09      | 0.01       |

Mean designated by the same letter are not significant different at the 5% level according to Duncan's multiple range test.

\*and\*\* significant at 0.05 and 0.01 levels of probability, respectively.

S1, S2 and C = first, second and combined analysis, respectively. r = Correlation coefficient between mid - parent and F1 performance.

plant height , height up to flag leaf and peduncle leaf region and number of spikelets per spike . While , it was intermediate in other traits . Giza 157 expressed high mean values for straw yield. Also, Giza 164 ranked the second of the tested parental lines in grain yield per plant. The parental varieties Giza 157 and Giza 164 were intermediate in most the traits . It is interesting to note that the superiority of the parental lines R.C.B70 and Giza 164 in grain yield resulted from a higher counted number of grains per spike , high mean values of 1000-grain weight and harvest index .

Data presented in Table (6), showed that crosses mean squares were significant for all the studied traits revealing an overall difference between these hybrids . Significant mean squares due to interaction between crosses and seasons were detected for all traits except heading date and flag leaf area . Such results indicated that these hybrids varied in their response to environmental fluctuations . The mean performances of F1 hybrids in each season and over both seasons are presented in Table (7). For heading date ,maturity date , plant height , height up to peduncle leaf and number of kernles per spike , the hybrids were within range of parental lines.

For region of peduncle leaf, the two crosses ( 2x3 ) and (4x8) had the highest mean values in the combined analysis. However, the cross (2x5) had the lowest one. The cross( 4x8) in the first season and cross (7x8) in the second season and the three crosses (2x5), (2x8) and (7x8 ) in the combined analysis, exhibited the highest number of tillers per plant.

For number of spikes per plant, the cross 4x8 in the first season , both crosses (2x5) and( 3x8) in the second season , and both crosses( 2x5) and( 1x8) in the combined analysis, had the highest mean values . However , the cross (2x9) had the lowest values of number of spikes per plant in the combined analysis.

The cross (8x9) had the highest values for flag leaf area followed by cross ( 6x7) in both seasons as well as the combined over them. Both crosses ( 2x9) and (3x7) exhibited the highest values for spike length in the combined analysis. However, the cross (3x4) had the lowest one in the combined analysis.

The cross between ( 3x7 )followed by crosses( 3x4) and (1x8) had the highest number of spikelets per spike in the combined analysis.

For 1000 - kernel weight, four, two and two crosses had the highest values in the first , second seasons as well as the combined analysis respectively. The two crosses (1x7) and (4x5) gave the highest mean values for 1000 - kernel weight in the combined analysis .

The cross (2x6) followed by cross (1x3) had the highest values for harvest index in the combined analysis, Also, the two crosses ( 1x3) and (2x7) showed that highest values for this trait in the first and second season, respectively.

The two crosses (8x9) and (4x6) in the first season and cross( 3x8) in the second season, and the two crosses (6x9) followed by cross (2x6) in the combined analysis, had the highest grain yield per plant. The high grain yield per plant in cross (6x9) could be attributed to high 1000 - Kernel weight, while, the high grain yield per plant of the cross (2x6) could be attributed to its high seed index and harvest index in the combined analysis . On the other hand, the high grain yield per plant of the other previous crosses could be attributed to one or more of number of kernels per spike, number of spikes per plant and flag leaf area. It could be concluded that these crosses would be efficient and prospective in wheat breeding programs for improving grain yield per plant .

The crosses between (4x6), (7x8) and (8x9) had the highest values of total plant weight per plant in the first , second seasons as well as the combined analysis. While , the two crosses( 4x6 ) and ( 1x6 ) in the first season , the cross (2x3) in the second season and three crosses (2x3), (6x9) and (7x9) in the combined analysis had the highest straw yield per plant. It could be concluded that the previous crosses would be efficient and prospective in wheat breeding programs for improving straw yield per plant .

Significant positive correlation coefficient values between mid- parent and F1 performance were detected for plant height and height up to flag leaf in both seasons as well as the combined analysis . Such results clarified between mid- parent values and F1 performance. consequently the best performance of F1 combination could be achieved by crossing between parental lines of high values.

Insignificant correlation coefficient values, meanwhile, were detected for all the rest traits, indicating that certain high and low parental lines may produce outstanding F1 hybrids in this concern . A relationship between the mean performance of their crosses were previously reached by Knott ( 1965 ), El-Shamarka ( 1980 ) and Darwish ( 1992). On the contrary , no or negative correlation the F1 performance were obtained by Gyawali et al., (1968 ), Bitzer (1972) Sharma and Singh (1983) and Sharma et al., (1986 )

### **Heterosis**

Mean squares for parent vs. crosses as an indication to average heterosis overall crosses was appreciable magnitude in both seasons as well as in their combined data analysis for all investigated traits except number of spikes per plant in the second seasons (Table 6) With the exception of harvest index and number of grains per spike in both season as well as the combined analysis strow yield and number of tillers per plant in the second season and grain yield per plant in the first

season, F1 mean were significantly higher than parental means for all the studied traits. Significant interaction between parents vs. crosses and season was detected for all the studied traits except heading date, plant height, height up to flag leaf, height of flag region, flag leaf area and 1000- kernel weight indicating that the heterotic effects were affected by the seasonal changes. For the exceptional traits, insignificant interaction between parent vs. crosses and season was detected. These results indicated that the heterotic effects were not affected by the seasonal changes.

Heterosis expressed as the percentage deviation of F1 performance from its mid -parents and better parent average value for all traits studied at both seasons and an average over the two seasons, are presented in Table (8) For heading date, twenty one in both seasons and twenty two crosses in the combined analysis, manifested significant negative heterosis from the mid- parents. Also, nine, six, and nine crosses of the previous hybrids had significant negative heterotic effects relative to mid -parent in the first, second seasons as well as the combined analysis, respectively. While, the cross (1x7) in the first season as well as the combined analysis and cross (1x8) in the second season, expressed significant negative heterotic effects relative to better parent. Significant negative heterotic effects for earliness was previously detected by Fonseca and Patterson (1968), El- shamarka (1980), Karrar (1980), Hendawy (1990), Darwish (1992), and Handawy (1994). However little or no heterotic effects for earliness were previously found by Chowdhry (1969), Mani and Rao (1975), and Mekhamer (1995).

Earliness, if found in wheat is favourable for escaping destructive injuries by stress conditions (Rust, high temp). The cross (1x7) as previously mentioned, expressed significant negative heterosis for maturity date. Hence it could be concluded that this cross is valuable in breeding for earliness and yield potentiality, whereas, this cross gave significant positive heterotic effect for grain yield and straw yield per plant.

**Table (8) : Percentage of heterosis over both mid- parent and better parent for studied traits.**

| Crosses | Heading date ( days) |         |         |                |         |         | Physiological maturity date ( days) |       |         |                |         |        | Plant height ( cm) |         |         |         |         |    |
|---------|----------------------|---------|---------|----------------|---------|---------|-------------------------------------|-------|---------|----------------|---------|--------|--------------------|---------|---------|---------|---------|----|
|         | S <sub>1</sub>       |         |         | S <sub>2</sub> |         |         | C                                   |       |         | S <sub>1</sub> |         |        | S <sub>2</sub>     |         |         | C       |         |    |
|         | MP                   | BP      | MP      | BP             | MP      | BP      | MP                                  | BP    | MP      | BP             | MP      | BP     | MP                 | BP      | MP      | BP      | MP      | BP |
| 1X2     | -7.59**              | -6.14** | -8.13** | -6.48**        | -7.86** | -6.31** | -1.79                               | -0.47 | -1.65   | 0.03           | -0.22   | -4.2** | 18.05**            | 2.22*   | 5.67**  | -99     | 11.86** |    |
| 1X3     | -6.55**              | -6.3**  | -6.49** | -6.29**        | -6.52** | -6.29   | 0.33                                | 1.54  | 0.27    | 1.09           | 1.31    | 9.6**  | 10.9**             | 5.8**   | 6.5**   | 7.70**  | 8.70**  |    |
| 1X4     | 0.56                 | 7.03**  | -0.12   | 6.16**         | 0.22    | 6.59**  | -1.05                               | -0.71 | -1.13   | -0.98          | -0.84   | 4.9**  | 5.9**              | 2.41*   | 2.84*   | 3.63**  | 4.37**  |    |
| 1X5     | -5.83**              | -4.98** | -5.38** | -4.68*         | -5.60** | -4.83** | -1.4                                | -0.95 | -1.44   | -0.76          | -0.85   | 5.2**  | 13**               | 4.08**  | 9.47**  | 4.64**  | 11.23** |    |
| 1X6     | -2.16                | 1.11    | -2.15*  | 1.27           | -2.15*  | 1.19    | -0.89                               | 0.22  | -0.28   | 0.53           | 0.37    | 2.9*   | 11.9**             | 4.66**  | 11.96** | 3.78**  | 11.93** |    |
| 1X7     | -1.87*               | 2.32**  | -1.32   | 2.72*          | -1.39   | 2.52*   | -10.3                               | -9.94 | -5.23** | 0.19           | -4.87** | -7.7** | 13.9**             | -3.7*   | 9.8**   | -5.70** | 11.85** |    |
| 1X8     | -2.41*               | 1.15    | -2.52*  | 0.76           | -2.46** | 0.95    | -2.5*                               | -2.21 | -2.57*  | -2.64*         | -2.42   | -1.4   | 3.5*               | -0.008  | 5.44**  | -0.70   | 4.47**  |    |
| 1X9     | -0.49                | 3.14**  | 0.75    | 2.89*          | 0.13    | 3.01**  | -0.09                               | 0.92  | 0.18    | 1.33           | 1.12    | 2.8*   | 9.2**              | 0.06    | 4*      | 1.43    | 6.60**  |    |
| 2X3     | -0.78                | 1.03    | -1.53   | 0.45           | -1.15   | 0.74    | -1.47                               | 1.06  | -1.54   | 0.82           | 0.94    | 10.8** | 16.2**             | 12.67** | 17.33** | 11.73** | 16.76** |    |
| 2X4     | -0.7                 | 7.42**  | -1.36   | 6.84**         | -1.03   | 7.13**  | -2.69*                              | -1.07 | -2.57*  | -0.67          | -0.87   | 13**   | 16.9**             | 10.99** | 20.34** | 11.99** | 18.72** |    |
| 2X5     | -1.13                | -0.5    | 0.10    | 0.93           | -0.51   | 0.21    | -1.9                                | -1.05 | -1.90   | -1.1           | 1.07    | 7.7**  | 10.63**            | 12.04** | 10.83** | 9.87**  | 10.74** |    |
| 2X6     | -6.24**              | -1.55   | -7.09** | -2.06          | -6.66** | -1.80   | -2.19*                              | -1.99 | -1.92   | -1.39          | -1.69   | 3.49*  | 7.5**              | 4.77*   | 1.47    | 4.13**  | 4.48**  |    |
| 2X7     | -3.25**              | 2.31*   | -2.65*  | 3.23*          | -2.95** | 2.87**  | -1.39                               | 0.41  | -1.43   | 0.49           | 0.45    | 7.4**  | 28.4**             | 6.76**  | 26.38** | 7.08**  | 27.39** |    |
| 2X8     | -4.98**              | 0.07    | -5.4**  | -0.39          | -5.19** | -0.16   | -2.83*                              | -1.14 | -2.70*  | -1.03          | -1.08   | 1.10   | 11.35**            | -1.23   | 7.84**  | -0.06   | 9.59**  |    |
| 2X9     | -2.5                 | 2.67**  | -2.56*  | 2.89*          | -2.53** | 2.78**  | -1.26                               | 1.1   | -1.31   | 1.08           | 1.09    | -1.90  | 6.03**             | 2.12*   | 10.54** | 0.11    | 8.29**  |    |
| 3X4     | 0.26                 | 6.4**   | 0.26    | 6.34**         | 0.26    | 6.37**  | 0.87                                | 1.74  | 1.23    | 2.25           | 1.23    | 9.4*   | 10.9**             | 11.89** | 12.16** | 10.64** | 11.53** |    |
| 3X5     | -4.64**              | -3.31** | -4.44** | -3.53*         | -4.54** | -3.52** | -0.93                               | 0.72  | -0.65   | 1.24           | 0.98    | 17.4** | 26.6**             | 17.7**  | -23.92  | 17.55** | 1.34    |    |
| 3X6     | -7.98**              | -5.16** | -8.59** | -5.6**         | -8.28** | -3.38** | -0.69                               | 1.64  | -0.62   | 1.62           | 1.63    | 3.9*   | 13.4**             | 7.22**  | 12.23** | 5.56**  | 12.81** |    |
| 3X7     | -5.37**              | -1.6    | -5.6**  | -1.95          | -5.48** | -1.77   | 0.42                                | 1.14  | 0.47    | 0.98           | 1.06    | 9.02** | 23.6**             | 7.34**  | 21.52** | 8.18**  | 22.56** |    |

**Table (8) : Percentage of heterosis over both mid- parent and better parent for studied traits.**

| crosses | Heading date ( days) |         |                |        |         |         | Physiological maturity date ( days) |        |                |        |         |        | Plant height ( cm) |         |                |         |         |         |
|---------|----------------------|---------|----------------|--------|---------|---------|-------------------------------------|--------|----------------|--------|---------|--------|--------------------|---------|----------------|---------|---------|---------|
|         | S <sub>1</sub>       |         | S <sub>2</sub> |        | C       |         | S <sub>1</sub>                      |        | S <sub>2</sub> |        | C       |        | S <sub>1</sub>     |         | S <sub>2</sub> |         | C       |         |
|         | MP                   | BP      | MP             | BP     | MP      | BP      | MP                                  | BP     | MP             | BP     | MP      | BP     | MP                 | BP      | MP             | BP      | MP      | BP      |
| 3X8     | -7.17**              | -4.05** | -7.32**        | -4.4** | -7.24** | -4.22** | 2.89*                               | 4.62** | 4.62**         | 5.53** | 3.75**  | 5.07** | 2.4*               | 2.2     | -1.08          | 3.56*   | 0.66    | 2.88*   |
| 3X9     | -2.8*                | 0.46    | -3.74*         | -0.42  | -3.27** | 0.02    | -0.08                               | 0.08   | 0.55           | 0.55   | 0.23    | 0.31   | 3.8*               | 6.9**   | 4.41*          | 8.51**  | 4.10**  | 7.70**  |
| 4X5     | -4.46**              | 3.3**   | -3.32*         | 3.57*  | -3.89** | 3.43**  | -2.29*                              | -1.51  | -2.49*         | -1.53  | 2.39**  | -1.52  | 10.00**            | 16.8**  | 11.31**        | 16.89** | 10.65** | 16.84** |
| 4X6     | -0.22                | 2.66*   | 0.78           | 1.8    | 0.28    | 2.23*   | -2.06*                              | -0.62  | -1.4           | 0.1    | -1.73   | -0.26  | 20.2**             | 29.4**  | 23.13**        | 32.28** | 21.66** | 30.84** |
| 4X7     | 4.77**               | 6.85**  | 4.09**         | 6.19** | 4.43**  | 6.52**  | 1.36                                | 1.5    | 1.85           | 2.03   | 1.60    | 1.76   | 7.5**              | 23.8**  | 3.03**         | 16.96** | 5.26**  | 20.38** |
| 4X8     | 3.25**               | 5.93**  | 2.84*          | 5.65** | 3.04**  | 5.79**  | -1.24                               | -0.04  | -0.61          | -0.39  | -0.92   | -0.21  | 10.2**             | 17.13** | 8.91**         | 14.35** | 9.55**  | 15.74** |
| 4X9     | 6.45**               | 9.21**  | 5.64**         | 8.22** | 6.04**  | 8.71**  | 0.23                                | 0.92   | 0.61           | 1.26   | 0.42    | 1.09   | 4.8*               | 9.4**   | 3.92*          | 8.29**  | 4.36**  | 8.84**  |
| 5X6     | -3.46**              | 0.7     | -2.97*         | 1.18   | -3.21** | 0.94    | -2.65*                              | -2.01  | -3.03**        | -2.51  | -2.84** | -2.26  | 19.07**            | 20.5**  | 18.12**        | 20.73** | 18.59** | 20.61** |
| 5X7     | 4.08**               | 9.55**  | 3.53**         | 8.61   | 3.80**  | 9.08**  | -0.33                               | 0.6    | -0.79          | 0.35   | -0.36   | 0.47   | -10.2              | 10.6**  | -6.34**        | 12.27** | -8.27** | 11.43** |
| 5X8     | -3.84**              | 0.6     | -3.53**        | 0.48   | -3.68** | 0.54    | -1.39                               | -1.58  | -0.39          | 0.16   | -1.09   | -0.71  | 6.4**              | 20.6**  | 3.04*          | 13.86** | 9.44**  | 17.18** |
| 5X9     | -3.45**              | 1.01    | -2.5*          | 1.82   | -2.97** | 1.41    | -1.38                               | 0.092  | -1.2           | 0.42   | -1.29   | 0.25   | 2.2*               | 20.5**  | 4.55*          | 14.61** | 3.37**  | 14.15** |
| 6X7     | -0.14                | 0.72    | -0.62          | -0.06  | 0.38    | 0.33    | -0.25                               | 1.35   | 0.18           | 1.91   | 0.03    | 1.63   | 15.9**             | 13.7**  | 11.3**         | 36.87** | 13.60** | 40.94** |
| 6X8     | -2.82**              | -2.55** | -2.25*         | -2.14  | -2.53** | -2.34*  | -0.47                               | 0.16   | 1.29           | 2.62*  | 0.41    | 1.39   | 12.23**            | 45.01** | 15.39**        | 30.59** | 13.81** | 29.74** |
| 6X9     | -1.84*               | -1.57   | -1.72          | -0.91  | -1.78*  | -1.24   | -2.28*                              | -0.16  | -1.56          | 0.59   | -1.92   | 0.21   | 12.89**            | 28.9**  | 13.05**        | 26.91** | 12.97** | 27.06** |
| 7X8     | 1.8*                 | 1.21    | 1.51           | 2.2    | 1.65    | 1.70    | -0.17                               | 0.78   | 1.52           | 2.14   | 0.67    | 1.46   | 5.09**             | 27.22** | 7.23**         | 15.55** | 6.16**  | 14.45** |
| 7X9     | -3.58**              | -3.03** | -4.04**        | -3.66  | -3.81** | -3.34** | 0.82                                | 1.37   | 0.45           | 0.91   | 0.63    | 1.14   | 2.71*              | 13.36** | 5.7**          | 14.79** | 4.20**  | 13.79** |
| 8X9     | -2.41*               | -2.41*  | -2.11*         | -1.84  | -2.26*  | -2.12*  | -0.75                               | 0.74   | -0.8           | 0.05   | 0.77    | 0.39   | 0.47               | 12.8**  | 3.02*          | 3.76*   | 1.74    | 2.97*   |

\* and \*\* denote significant differences from zero at 0.5 and 0.1 levels probability, respectively. 2.19 S1, S2 C= first, second and combined analysis respectively. MP and BP mid and better, respectively.



**Table (8) : Percentage of heterosis over both mid- parent and better parent for studied traits.**

| Crosses     | Height up to flag leaf (cm) |          |         |                |         |          | Height of flag region (cm) |          |          |                |         |         | Flag leaf area (cm <sup>2</sup> ) |         |         |         |      |      |
|-------------|-----------------------------|----------|---------|----------------|---------|----------|----------------------------|----------|----------|----------------|---------|---------|-----------------------------------|---------|---------|---------|------|------|
|             | S <sub>1</sub>              |          |         | S <sub>2</sub> |         |          | C                          |          |          | S <sub>1</sub> |         |         | S <sub>2</sub>                    |         |         | C       |      |      |
|             | MP                          | BP       | BP      | MP             | BP      | BP       | MP                         | BP       | BP       | MP             | BP      | BP      | MP                                | BP      | BP      | MP      | BP   | BP   |
| 1X2 11.68** | 17.5**                      | -0.85    | 4.9     | 5.41**         | 11.20** | -5.5*    | 13.21**                    | 9.62**   | 11.88**  | 2.06           | 12.54** | 5.9**   | -10**                             | 6.3**   | -0.33   | 6.10**  | -516 | -316 |
| 1X3 6**     | 7.23**                      | 7.01**   | 9.11**  | 6.50**         | 8.17**  | 17.18**  | 17.6**                     | 2.87     | 10.29**  | 10.02**        | 13.94** | -9.03** | -7.63**                           | -8.37** | -9.14** | -8.7**  | -838 | -838 |
| 1X4 0.02    | 0.67                        | -2.66    | -2.11   | -1.32          | -0.72   | 16.83**  | 22.6**                     | 15.31**  | 15.38**  | 16.07**        | 31.20** | 3.43*   | 2.26                              | 1.41    | 0.53    | 2.42    | 139  | 139  |
| 1X5 -3.73*  | 2.06                        | 0.92     | 4.59    | -1.40          | 3.32    | 26.39**  | 39.5**                     | 14.65**  | 22.9**   | 20.52**        | 31.20** | 2.37    | 2.37                              | 3.54*   | 2.53    | 2.95*   | 245  | 245  |
| 1X6 13.57** | 23.86**                     | 6.15*    | 17.01** | 9.86**         | 20.43** | -20.2**  | -14.3**                    | 1.17     | 1.27     | -9.51**        | -6.51** | -1.75   | -9.42**                           | -1.75   | -9.15** | -3.50*  | -93* | -93* |
| 1X7 -7.88** | 15.74**                     | -12.13** | 3.36    | -10.00**       | 9.53**  | -24.07** | -20.04**                   | 20.37**  | 26.19**  | -1.85          | 3.07    | 9.85**  | 4.5*                              | 6.91**  | 2.13    | 8.38**  | 311* | 311* |
| 1X8 -0.6    | 11.99**                     | -7.53**  | -2.9    | -4.06*         | 4.54*   | -16.5**  | -14.7**                    | 18.99**  | 26.82**  | 1.24           | 6.06**  | 1.64    | -0.04                             | 1.08    | -0.14   | 1.36    | -009 | -009 |
| 1X9 -1.16   | 6.85*                       | 4.56     | 9.59**  | 1.70           | 8.22**  | 4.94*    | 5.56*                      | -11.53** | -7.8**   | -3.29          | -1.12   | 4.77*   | -1.63                             | 8.31**  | 2.67    | 6.54**  | 032  | 032  |
| 2X3 0.8     | 6.81*                       | 2.46**   | 12.47** | 4.63*          | 9.64**  | 33.6**   | 36.5**                     | 21.87**  | 27.89**  | 27.73**        | 32.19** | 18.81** | 10.59**                           | 17.8**  | 9.58**  | 18.30** | 1808 | 1808 |
| 2X4 8.46**  | 14.9**                      | 20.69**  | 28.47** | 14.57**        | 21.68** | 23.03**  | 21.6**                     | 5.19*    | 7.30**   | 14.12**        | 16.45** | 5.1*    | -1.81                             | 4.36*   | -1.33   | 4.73**  | -157 | -157 |
| 2X5 16.4**  | 17.23**                     | 10.23**  | 12.47** | 13.31**        | 14.83** | -11.4**  | -5.35*                     | 16.61**  | 27.63**  | 2.60           | 11.14** | 18.92** | 12.3**                            | 18.13** | 11.79** | 18.52** | 1204 | 1204 |
| 2X6 3.67*   | 7.2*                        | 16.08**  | 20.66** | 9.87**         | 13.93** | 9.12**   | 14.50**                    | -19.5**  | -17.83** | -5.19**        | -1.66   | 3.97*   | -9.03**                           | 3.76*   | -9.55** | 3.86**  | -929 | -929 |
| 2X7 3.88*   | 29.72**                     | 4.93*    | 31.71** | 4.40*          | 30.71** | 16.17**  | 21.74**                    | 11.9**   | 14.98**  | 14.03**        | 20.56** | 13.08   | 1.66                              | 15.25** | 3.55*   | 14.16** | 245  | 245  |
| 2X8 -0.07   | 12.5**                      | 2.99     | 8.06**  | 1.46           | 10.28** | 3.71*    | 8.79**                     | 3.07     | 7.64*    | 3.39           | 8.21**  | 27.65** | 22.16**                           | 7.83**  | 2.26    | 17.74** | 1221 | 1221 |
| 2X9 9.6**   | 21**                        | 3.73     | 15.35** | 6.66**         | 18.17** | 0.46     | 3.74*                      | -2.08    | 0.61     | -0.81          | 2.17    | 5.13*   | 4.77*                             | 3.52*   | 2.3     | 4.32**  | 353* | 353* |
| 3X4 8.9**   | 8.9**                       | 20.32**  | 23.39** | 14.61**        | 16.14** | 11.27**  | 16.09**                    | -7.83**  | -1.26    | 1.71           | 7.41**  | 11.37** | 10.93**                           | 10.63** | 8.74**  | 11**    | 953* | 953* |
| 3X5 19.72** | 28.1**                      | 22.93**  | 24.9**  | 21.32**        | 26.50** | 12.63**  | 23.7**                     | 5.14*    | 21.45**  | 8.88**         | 22.57** | 15.98** | 14.22**                           | 14.23** | 12.19** | 15.11** | 1320 | 1320 |
| 3X6 2.6     | 12.8**                      | 2.18     | 10.3**  | 2.39           | 11.55** | 7.15**   | 15.02**                    | 8.60**   | 16.56**  | 7.87**         | 15.79** | -0.66   | -7.13**                           | -2.33   | -8.99** | -1.49   | -806 | -806 |
| 3X7 7.5**   | 25.7**                      | 11.64**  | 34.31** | 9.57**         | 30.00** | 13.3**   | 19.79**                    | -3.02    | -1.73    | 5.14**         | 9.03**  | 1.33    | -2.24                             | 2.73*   | -1.06   | 2.13    | -165 | -165 |

\* and \*\* denote significant differences from zero at 0.5 and 0.1 levels probability, respectively.  
S1, S2 C= first, second mid combined analysis respectively. MP and BP mid and better parent respectively.

**Table (8) :Percentage of heterosis over both mid- parent and better parent for studied traits.**

| Table (8) :Percentage of heterosis over both mid- parent and better parent for |                              |         |          |                |          |         |                             |         |         |                |          |          |                                    |          |          |         |         |         |                |         |         |                |         |         |         |         |    |
|--------------------------------------------------------------------------------|------------------------------|---------|----------|----------------|----------|---------|-----------------------------|---------|---------|----------------|----------|----------|------------------------------------|----------|----------|---------|---------|---------|----------------|---------|---------|----------------|---------|---------|---------|---------|----|
| crosses                                                                        | Height up to flag leaf ( cm) |         |          |                |          |         | Height of flag region ( cm) |         |         |                |          |          | Flag leaf area ( cm <sup>2</sup> ) |          |          |         |         |         |                |         |         |                |         |         |         |         |    |
|                                                                                | S <sub>1</sub>               |         |          | S <sub>2</sub> |          |         | C                           |         |         | S <sub>1</sub> |          |          | S <sub>2</sub>                     |          |          | C       |         |         | S <sub>1</sub> |         |         | S <sub>2</sub> |         |         | C       |         |    |
|                                                                                | MP                           | BP      | BP       | MP             | BP       | BP      | MP                          | BP      | BP      | MP             | BP       | BP       | MP                                 | BP       | BP       | MP      | BP      | BP      | MP             | BP      | BP      | MP             | BP      | BP      | MP      | BP      | BP |
| 3X8                                                                            | -2.4                         | 3.3     | -2.64    | 4.32           | -2.52    | 3.81    | 2.51                        | 3.08    | 0.05    | 1.59           | 13.54**  | 10.3**   | 12.09**                            | 9.83**   | 12.81**  | 10.06** | 10.06** | 10.06** | 10.06**        | 10.06** | 10.06** | 10.06**        | 10.06** | 10.06** | 10.06** | 10.06** |    |
| 3X9                                                                            | 6.7**                        | 10.44** | 2.85     | 10.02**        | 4.77*    | 10.23** | 8.13**                      | 11.14** | 2.81    | 4.83*          | 0.95     | -8.09**  | -2.04                              | -7.86**  | -1.49    | -7.97** | -7.97** | -7.97** | -7.97**        | -7.97** | -7.97** | -7.97**        | -7.97** | -7.97** | -7.97** | -7.97** |    |
| 4X5                                                                            | 6.3**                        | 13.5    | 4.44     | 8.87**         | 5.37**   | 11.18** | 29.49**                     | 38.90** | 24.79** | 32.38**        | 5.8**    | 4.6*     | 4.53*                              | 4.42*    | 5.16**   | 4.51**  | 4.51**  | 4.51**  | 4.51**         | 4.51**  | 4.51**  | 4.51**         | 4.51**  | 4.51**  | 4.51**  | 4.51**  |    |
| 4X6                                                                            | 19.8**                       | 31.6**  | 31.93**  | 46.33**        | 25.86**  | 38.96** | 21.2**                      | 24.53** | 24.79** | 13.53**        | -12.56** | -18.54** | -10.41**                           | -17.83** | -11.48** | 10.18** | 10.18** | 10.18** | 10.18**        | 10.18** | 10.18** | 10.18**        | 10.18** | 10.18** | 10.18** | 10.18** |    |
| 4X7                                                                            | 5.48**                       | 23.33** | -3.1     | 13.25**        | 1.19     | 18.29** | 13.12**                     | 25.17** | 16.86** | 25.75**        | -6.56**  | -10.33** | -3.8*                              | -8.88**  | -5.18**  | -9.61** | -9.61** | -9.61** | -9.61**        | -9.61** | -9.61** | -9.61**        | -9.61** | -9.61** | -9.61** | -9.61** |    |
| 4X8                                                                            | -5.19**                      | 0.46    | 10.73**  | 15.39**        | 2.77     | 8.02**  | 47.4**                      | 57.98** | 4.32*   | 34.54**        | 1.46     | -1.07    | 4.12*                              | 3.77*    | 2.79*    | 1.35    | 1.35    | 1.35    | 1.35           | 1.35    | 1.35    | 1.35           | 1.35    | 1.35    | 1.35    | 1.35    |    |
| 4X9                                                                            | 8.34**                       | 12.63** | 3.8      | 8.16**         | 6.07**   | 10.39** | -3.84*                      | 1.42    | 8.57**  | 4.99*          | 6.73**   | -0.59    | 10.83**                            | 5.95**   | 8.76**   | 2.68    | 2.68    | 2.68    | 2.68           | 2.68    | 2.68    | 2.68           | 2.68    | 2.68    | 2.68    | 2.68    |    |
| 5X6                                                                            | 13.96**                      | 17.06** | 19.32**  | 26.66**        | 16.64**  | 21.86** | 31.01**                     | 33.92** | 23.32** | 21.10**        | 9.08**   | 0.56     | 8.94**                             | -0.16    | 9.01**   | 0.20    | 0.20    | 0.20    | 0.20           | 0.20    | 0.20    | 0.20           | 0.20    | 0.20    | 0.20    | 0.20    |    |
| 5X7                                                                            | -16.9**                      | 4.67*   | -18.07** | 0.46           | -17.48** | 2.56    | 7.18**                      | 25.25** | 28.38** | 34.98**        | -0.61    | -5.68**  | -1.71                              | -6.98**  | 4.27**   | -4.33** | -4.33** | -4.33** | -4.33**        | -4.33** | -4.33** | -4.33**        | -4.33** | -4.33** | -4.33** | -4.33** |    |
| 5X8                                                                            | -6.46**                      | 6.17*   | -1.17    | 7.71*          | -3.81    | 6.94**  | 19.62**                     | 35.22** | 14**    | 16.81**        | -3.62*   | -4.97**  | -2.29                              | -4.91**  | -2.95*   | -4.94** | -4.94** | -4.94** | -4.94**        | -4.94** | -4.94** | -4.94**        | -4.94** | -4.94** | -4.94** | -4.94** |    |
| 5X9                                                                            | 1.9                          | 13.38** | 2.6      | 11.62**        | 2.25     | 12.50** | 3                           | 34.3**  | 9.74**  | 18.7**         | 10.76**  | 4.26**   | 10.18**                            | 5.43**   | 10.67**  | 4.64**  | 4.64**  | 4.64**  | 4.64**         | 4.64**  | 4.64**  | 4.64**         | 4.64**  | 4.64**  | 4.64**  | 4.64**  |    |
| 6X7                                                                            | 13.41**                      | 47.52** | 15.31**  | 51.62**        | 14.36**  | 49.57** | 22.37**                     | 39.32** | 11.56** | 22.62**        | 6.5**    | 3.37*    | 4.13*                              | 0.61     | 5.31**   | 1.99    | 1.99    | 1.99    | 1.99           | 1.99    | 1.99    | 1.99           | 1.99    | 1.99    | 1.99    | 1.99    |    |
| 6X8                                                                            | 6.7**                        | 24.92** | 25.91**  | 46.37**        | 16.30**  | 31.64** | 24.83**                     | 37.7*   | -2.54   | 17.38**        | -7.7**   | -16.06** | -9.52**                            | -17.27** | -8.61**  | -16.6** | -16.6** | -16.6** | -16.6**        | -16.6** | -16.6** | -16.6**        | -16.6** | -16.6** | -16.6** | -16.6** |    |
| 6X9                                                                            | 19.57**                      | 37.02** | 13.6**   | 31.81**        | 16.58**  | 34.41** | -2.7                        | 5.61*   | 11.73** | 11.08**        | 12.2**   | -2.1     | 10.89**                            | -236     | 11.55**  | -2.23   | -2.23   | -2.23   | -2.23          | -2.23   | -2.23   | -2.23          | -2.23   | -2.23   | -2.23   | -2.23   |    |
| 7X8                                                                            | 4.44*                        | 14.55** | 1.67     | 13.36**        | 3.05     | 13.93** | 6.48**                      | 9.7**   | 22.68** | 14.38**        | -1.32    | -7.6**   | -0.75                              | -6.27*   | -1.83    | -6.93** | -6.93** | -6.93** | -6.93**        | -6.93** | -6.93** | -6.93**        | -6.93** | -6.93** | -6.93** | -6.93** |    |
| 7X9                                                                            | 6.27**                       | 19.01** | -0.13    | 11.55**        | 3.07     | 15.28** | -6.6**                      | -2.25   | 22.44** | 10.43**        | -6.22**  | -15.9**  | -4.73*                             | -13.49** | -5.47**  | -14.6** | -14.6** | -14.6** | -14.6**        | -14.6** | -14.6** | -14.6**        | -14.6** | -14.6** | -14.6** | -14.6** |    |
| 8X9                                                                            | -6.5**                       | -4.7*   | -0.96    | -0.79          | -3.73    | -2.74   | 17.17**                     | 18.96** | 7.31**  | 14.31**        | 34.53**  | 28.32**  | 30.42**                            | 25.08**  | 32.47    | 26.7**  | 26.7**  | 26.7**  | 26.7**         | 26.7**  | 26.7**  | 26.7**         | 26.7**  | 26.7**  | 26.7**  | 26.7**  |    |

\*denotes significant differences from zero at 0.5 and 0.1 levels probability, respectively.  
C- first, second and combined analysis respectively. MP and BP mid and better parent respectively.

**Table (8) : Percentage of heterosis over both mid- parent and better parent for studied traits.**

| Crosses | Number of tillers per plant |         |          |          |         |          |         |         |          |          | Splice length (cm) |         |          |         |         |                |         |    |    |    |
|---------|-----------------------------|---------|----------|----------|---------|----------|---------|---------|----------|----------|--------------------|---------|----------|---------|---------|----------------|---------|----|----|----|
|         | S <sub>1</sub>              |         |          |          |         | C        |         |         |          |          | S <sub>1</sub>     |         |          |         |         | S <sub>2</sub> |         |    |    |    |
|         | MP                          | BP      | MP       | BP       | MP      | BP       | MP      | BP      | MP       | BP       | MP                 | BP      | MP       | BP      | MP      | MP             | BP      | MP | BP | BP |
| 1X2     | -3.49**                     | -6.06** | -8.72**  | -15.45** | -6.10** | -10.75** | -0.94   | -2.48*  | 2.62*    | 1.97     | 0.84               | -0.25   | 1.98*    | -4.46** | -5.97** | -2.09**        | -3.97** |    |    |    |
| 1X3     | 7.04**                      | 5.09*   | -15.1**  | -19.96** | -4.03** | -7.43**  | 11.81** | 10.62** | 0.7      | 0.14     | 6.25**             | 5.38**  | 1.38*    | 5.62**  | 1.72*   | 3.50**         | 0.02    |    |    |    |
| 1X4     | 23.95**                     | 22.33** | -12.38** | -16.97** | 5.78**  | 2.68*    | 27.11** | 24.39** | -6.28**  | -7.91**  | 10.41**            | 8.24**  | 9.8**    | 3.98**  | 1.62*   | 6.89**         | 2.70**  |    |    |    |
| 1X5     | 9.25**                      | 4.77*   | 7.06**   | 1.24     | 8.15**  | 3**      | 13.53** | 11.21** | 2.57*    | -2.17*   | 8.05**             | 4.52**  | 12.83**  | 0.33*   | -4.58** | 6.68**         | 1.82**  |    |    |    |
| 1X6     | 21.82**                     | 11.35** | -5.32**  | -10.59** | 8.25**  | 0.38     | 31.23** | 16.87** | -1.66    | -7.08**  | 14.78**            | 4.89**  | 5.45**   | 17.14** | 14.07** | 11.29**        | 9.20**  |    |    |    |
| 1X7     | 19.42**                     | 18.7**  | -13.64** | -21.33** | 2.89**  | -1.31    | 28.13** | 26.69** | -9.23**  | -9.4**   | 9.45**             | 8.64**  | 12.9**   | 7.99**  | 5.19**  | 10.44**        | 7.96**  |    |    |    |
| 1X8     | 36.43**                     | 23.25** | 10.34**  | 6.84**   | 23.38** | 15.04**  | 42.6**  | 28.13** | 13.81**  | 10.65**  | 28.20**            | 19.39** | 6.25**   | 15.99** | 14.11** | 11.12**        | 9.73**  |    |    |    |
| 1X9     | 27.8**                      | 21.35** | -9.52**  | -13.44** | 9.14**  | 3.95**   | 9.13**  | 3.95*   | 4.86**   | 20.8**   | 6.99**             | 12.57** | 14.82**  | 5.96**  | 3.81**  | 10.39**        | 8.77**  |    |    |    |
| 2X3     | 21.28**                     | 15.89** | -26.96** | -28.34** | -2.84** | -6.22**  | 17.32** | 14.34** | -19.98** | -20.9**  | -1.33              | -3.28** | 6.77**   | 5.84**  | 3.53**  | 6.30**         | 4.72**  |    |    |    |
| 2X4     | 24.16**                     | 22.88** | -11.09** | -13.24** | 6.53**  | 4.82**   | 17.39** | 14.29** | 5.02**   | 3.84*    | 11.20**            | 9.06**  | 5.39**   | -2.59** | -6.7**  | 1.27**         | -4.6**  |    |    |    |
| 2X5     | 18.46**                     | 10.69** | 8.86**   | -4.21*   | 13.66** | 3.24**   | 20.13** | 19.43** | 19.49**  | 13.26**  | 19.81**            | 16.33** | 11.63**  | 7.1**   | 3.2**   | 9.37**         | 3.99**  |    |    |    |
| 2X6     | 31.29**                     | 23.07** | -7.79**  | -18.97** | 11.75** | 2.05     | 35.29** | 18.9**  | 8.03**   | 1.51     | 21.68**            | 10.20** | 9.35**   | 8.13**  | 10.17** | 9.86**         | 7.79**  |    |    |    |
| 2X7     | 20.16**                     | 17.56** | -17.83** | -19.3**  | 1.16    | -0.87    | 23.39** | 20.19** | 1.52     | 0.73     | 12.45**            | 10.46** | 11.76**  | 10.81** | 6.28**  | 11.28**        | 6.72**  |    |    |    |
| 2X8     | 43.96**                     | 35.33** | -1.83    | -11.73** | 21.06** | 10.80**  | 30.84** | 16.02** | 8.99**   | 5.3**    | 19.91**            | 10.66** | 8.6**    | 12.48** | 8.95**  | 10.34**        | 7.96**  |    |    |    |
| 2X9     | 31.37**                     | 28.2**  | -25.98** | -28.45** | 2.79**  | -0.12    | 5.23**  | -1.19   | -15.06** | -16.2**  | -4.91**            | 7.30**  | -13.91** | 10.25** | 14.25** | 0.17           | 10.2**  |    |    |    |
| 3X4     | 15**                        | 5.14*   | -16.59** | -17.04** | -0.79   | -5.95**  | 17.13** | 17.01** | -10.52** | -12.52** | 3.30**             | 2.24*   | -16.11** | 6.94**  | 0.75*   | 11.32**        | 3.67**  |    |    |    |
| 3X5     | 13.82**                     | 11.19** | -4.65**  | -14.71** | 4.58**  | -1.76    | 26.78** | 2.88*   | 1.56     | -2.67*   | 14.17**            | 0.10    | 10.68**  | -0.07   | -1.67*  | 5.30**         | 0.71*   |    |    |    |
| 3X6     | 22.2**                      | 9.86**  | 2.53*    | -8.39**  | 12.36** | 0.73     | 38.99** | 24.5**  | 13.45**  | 7.77**   | 26.22**            | 16.33** | 1.16*    | -0.94*  | 4.41**  | 2.78**         | 1.14**  |    |    |    |
| 3X7     | 8.76**                      | 6.17**  | -20.69** | -23.57** | -5.96** | -8.7**   | 13.14** | 13.08** | -11.89** | -12.21** | 0.62               | 0.43    | 11.8**   | 6.38**  | 15.76** | 13.78**        | 7.58**  |    |    |    |

\*Anno significant differences from zero at 0.5 and 0.1 levels probability, respectively.  
C- first, second and combined analysis respectively. MP and BP mid and better parent respectively.

**Table (8) : Percentage of heterosis over both mid- parent and better parent for studied traits.**

| Obsess | Number of offsprs per plant |                      |                       |                       |                      |                       | Number of offsprs per plant |                      |                       |                       |                      |                      | Splice length ( cm)  |                      |                      |                      |                      |                      |
|--------|-----------------------------|----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------------|----------------------|-----------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|        | S <sub>1</sub>              |                      |                       | C                     |                      |                       | S <sub>1</sub>              |                      |                       | S <sub>2</sub>        |                      |                      | S <sub>1</sub>       |                      |                      | S <sub>2</sub>       |                      |                      |
|        | BP                          |                      | MP                    | BP                    |                      | MP                    | BP                          |                      | MP                    | BP                    |                      | MP                   | BP                   |                      | MP                   | BP                   |                      | MP                   |
|        | BP                          | MP                   | BP                    | MP                    | BP                   | MP                    | BP                          | MP                   | BP                    | MP                    | BP                   | MP                   | BP                   | MP                   | BP                   | MP                   | BP                   | MP                   |
| 3X3    | 23.67 <sup>***</sup>        | 11.48 <sup>***</sup> | 7.46 <sup>***</sup>   | -1.71                 | 16.56 <sup>***</sup> | 4.98 <sup>***</sup>   | 34.67 <sup>***</sup>        | 22.19 <sup>***</sup> | 16.04 <sup>***</sup>  | -2.37 <sup>*</sup>    | -4.76 <sup>***</sup> | 7.93 <sup>***</sup>  | 17.78 <sup>***</sup> | 6.46 <sup>***</sup>  | 4.03 <sup>***</sup>  | 10.22 <sup>***</sup> | 4.31 <sup>***</sup>  | 8.34 <sup>***</sup>  |
| 3X9    | 11.33 <sup>***</sup>        | 3.78 <sup>*</sup>    | -17.09 <sup>***</sup> | -18.36 <sup>***</sup> | -2.88 <sup>***</sup> | -7.29 <sup>***</sup>  | 18.24 <sup>***</sup>        | 13.79 <sup>***</sup> | -2.37 <sup>*</sup>    | -4.76 <sup>***</sup>  | 7.93 <sup>***</sup>  | 17.78 <sup>***</sup> | 6.46 <sup>***</sup>  | 4.03 <sup>***</sup>  | 10.22 <sup>***</sup> | 4.31 <sup>***</sup>  | 8.34 <sup>***</sup>  | 4.27 <sup>***</sup>  |
| 4X3    | 6.26 <sup>***</sup>         | 0.62                 | -0.78                 | -10.81 <sup>***</sup> | 2.74 <sup>***</sup>  | -5.09 <sup>***</sup>  | 10.62 <sup>***</sup>        | 7.11 <sup>***</sup>  | -0.71                 | -6.88 <sup>***</sup>  | 4.95 <sup>***</sup>  | 0.11                 | 16.28 <sup>***</sup> | 16.28 <sup>***</sup> | 4.07 <sup>***</sup>  | -3.33 <sup>***</sup> | 10.17 <sup>***</sup> | 6.46 <sup>***</sup>  |
| 4X6    | 23.86 <sup>***</sup>        | 14.6 <sup>***</sup>  | -10.52 <sup>***</sup> | -19.67 <sup>***</sup> | 6.67 <sup>***</sup>  | -2.33 <sup>*</sup>    | 27.5 <sup>***</sup>         | 14.73 <sup>***</sup> | -1.1                  | -8.05 <sup>***</sup>  | 13.2 <sup>***</sup>  | 3.35 <sup>***</sup>  | 11.6 <sup>***</sup>  | 11.6 <sup>***</sup>  | 4.41 <sup>***</sup>  | 6.05 <sup>***</sup>  | 1.00 <sup>*</sup>    | 2.70 <sup>***</sup>  |
| 4X7    | 13.74 <sup>***</sup>        | 12.83 <sup>***</sup> | -23.47 <sup>***</sup> | -28.53 <sup>***</sup> | -1.86 <sup>***</sup> | -7.85 <sup>***</sup>  | 17.58 <sup>***</sup>        | 17.52 <sup>***</sup> | -8.88 <sup>***</sup>  | -10.59 <sup>***</sup> | 4.35 <sup>***</sup>  | 3.47 <sup>***</sup>  | 17.24 <sup>***</sup> | 12.88 <sup>***</sup> | 17.39 <sup>***</sup> | 16.99 <sup>***</sup> | 17.31 <sup>***</sup> | 14.93 <sup>***</sup> |
| 4X8    | 54.96 <sup>***</sup>        | 41.67 <sup>***</sup> | -19.43 <sup>***</sup> | -25.94 <sup>***</sup> | 17.76 <sup>***</sup> | 7.86 <sup>***</sup>   | 36.43 <sup>***</sup>        | 42.07 <sup>***</sup> | -12.53 <sup>***</sup> | -16.4 <sup>***</sup>  | 21.95 <sup>***</sup> | 12.83 <sup>***</sup> | 17 <sup>***</sup>    | 18.9 <sup>***</sup>  | 13.51 <sup>***</sup> | 6.32 <sup>***</sup>  | 8.96 <sup>***</sup>  | 9.43 <sup>***</sup>  |
| 4X9    | 29.66 <sup>***</sup>        | 24.62 <sup>***</sup> | -17.89 <sup>***</sup> | -18.71 <sup>***</sup> | 5.88 <sup>***</sup>  | 2.95 <sup>***</sup>   | 11.23 <sup>***</sup>        | 7.13 <sup>***</sup>  | -11.37 <sup>***</sup> | -11.57 <sup>***</sup> | -0.07                | -2.21 <sup>*</sup>   | 18.9 <sup>***</sup>  | 10.63 <sup>***</sup> | 5.04 <sup>***</sup>  | -1.42 <sup>*</sup>   | 4.60 <sup>***</sup>  | 0.48                 |
| 5X6    | 13.39 <sup>***</sup>        | 1.6                  | 13.29 <sup>***</sup>  | 13.13 <sup>***</sup>  | 14.34 <sup>***</sup> | 7.36 <sup>***</sup>   | 26.34 <sup>***</sup>        | 10.49 <sup>***</sup> | 12.98 <sup>***</sup>  | 11.89 <sup>***</sup>  | 19.66 <sup>***</sup> | 11.19 <sup>***</sup> | 10.63 <sup>***</sup> | 14.83 <sup>***</sup> | 12.28 <sup>***</sup> | 4.87 <sup>***</sup>  | -2.91 <sup>***</sup> | 9.86 <sup>***</sup>  |
| 5X7    | -0.3                        | -4.9 <sup>*</sup>    | -3.95 <sup>*</sup>    | -16.8 <sup>***</sup>  | -2.15 <sup>*</sup>   | -10.83 <sup>***</sup> | 9.24 <sup>***</sup>         | 5.8 <sup>***</sup>   | 9.09 <sup>***</sup>   | 4.18 <sup>***</sup>   | 9.16 <sup>***</sup>  | 4.99 <sup>***</sup>  | 14.83 <sup>***</sup> | 12.28 <sup>***</sup> | 4.87 <sup>***</sup>  | 7.32 <sup>***</sup>  | 0.29                 | 7.06 <sup>***</sup>  |
| 5X8    | 29.83 <sup>***</sup>        | 13.06 <sup>***</sup> | -1.58                 | -3.96 <sup>*</sup>    | 14.13 <sup>***</sup> | 4.35 <sup>***</sup>   | 43.99 <sup>***</sup>        | 66.06 <sup>***</sup> | -7.3 <sup>***</sup>   | -9.31 <sup>***</sup>  | 18.24 <sup>***</sup> | 28.37 <sup>***</sup> | 6.8 <sup>***</sup>   | 1.6 <sup>*</sup>     | 7.32 <sup>***</sup>  | 0.29                 | 7.06 <sup>***</sup>  | 0.94 <sup>***</sup>  |
| 5X9    | 14.36 <sup>***</sup>        | 4.32 <sup>*</sup>    | -9.42 <sup>***</sup>  | -17.84 <sup>***</sup> | 2.47 <sup>***</sup>  | -6.76 <sup>***</sup>  | 16.06 <sup>***</sup>        | 8.39 <sup>***</sup>  | -9.79 <sup>***</sup>  | -15.38 <sup>***</sup> | 3.13 <sup>***</sup>  | -3.39 <sup>***</sup> | 12.59 <sup>***</sup> | 12.59 <sup>***</sup> | 7.98 <sup>***</sup>  | 0.5 <sup>*</sup>     | 10.28 <sup>***</sup> | 2.82 <sup>***</sup>  |
| 6X7    | 22.98 <sup>***</sup>        | 13.15 <sup>***</sup> | -5.67 <sup>***</sup>  | -18.39 <sup>***</sup> | 8.63 <sup>***</sup>  | -2.62 <sup>*</sup>    | 38.34 <sup>***</sup>        | 24.43 <sup>***</sup> | 7.8 <sup>***</sup>    | 2.04                  | 23.09 <sup>***</sup> | 13.24 <sup>***</sup> | 4.1 <sup>***</sup>   | 4.1 <sup>***</sup>   | 1.21 <sup>*</sup>    | 1.21 <sup>*</sup>    | -3.84 <sup>***</sup> | -1.39 <sup>***</sup> |
| 6X8    | 43.44 <sup>***</sup>        | 41.59 <sup>***</sup> | 11.38 <sup>***</sup>  | 8.53 <sup>***</sup>   | 27.41 <sup>***</sup> | 23.06 <sup>***</sup>  | 46.78 <sup>***</sup>        | 43.31 <sup>***</sup> | 12.57 <sup>***</sup>  | 9.31 <sup>***</sup>   | 29.67 <sup>***</sup> | 27.31 <sup>***</sup> | -3.37 <sup>***</sup> | -3.37 <sup>***</sup> | 7.78 <sup>***</sup>  | 3.3 <sup>***</sup>   | 2.20 <sup>***</sup>  | -0.13                |
| 6X9    | 40.6 <sup>***</sup>         | 35.13 <sup>***</sup> | -10.26 <sup>***</sup> | -18.7 <sup>***</sup>  | 15.17 <sup>***</sup> | 8.21 <sup>***</sup>   | 45.56 <sup>***</sup>        | 35.61 <sup>***</sup> | -6.62 <sup>***</sup>  | -13.35 <sup>***</sup> | 19.47 <sup>***</sup> | 11.13 <sup>***</sup> | 7.31 <sup>***</sup>  | 7.31 <sup>***</sup>  | 10.15 <sup>***</sup> | 5.15 <sup>***</sup>  | 8.83 <sup>***</sup>  | 5.23 <sup>***</sup>  |
| 7X8    | 29.72 <sup>***</sup>        | 17.76 <sup>***</sup> | 8.42 <sup>***</sup>   | -4.06 <sup>***</sup>  | 19.07 <sup>***</sup> | 6.83 <sup>***</sup>   | 40.58 <sup>***</sup>        | 27.01 <sup>***</sup> | 9.87 <sup>***</sup>   | 6.97 <sup>***</sup>   | 25.22 <sup>***</sup> | 16.99 <sup>***</sup> | 3.33 <sup>***</sup>  | 3.33 <sup>***</sup>  | 14.05 <sup>***</sup> | 12.9 <sup>***</sup>  | 8.69 <sup>***</sup>  | 6.69 <sup>***</sup>  |
| 7X9    | 17.28 <sup>***</sup>        | 11.8 <sup>***</sup>  | -20.85 <sup>***</sup> | -24.82 <sup>***</sup> | -1.78                | 6.51 <sup>***</sup>   | 24.71 <sup>***</sup>        | 20.08 <sup>***</sup> | -6.04 <sup>***</sup>  | -8.01 <sup>***</sup>  | 9.33 <sup>***</sup>  | 6.03 <sup>***</sup>  | 9.73 <sup>***</sup>  | 8.69 <sup>***</sup>  | 5.69 <sup>***</sup>  | 5.07 <sup>***</sup>  | 7.71 <sup>***</sup>  | 6.88 <sup>***</sup>  |
| 8X9    | 24.88 <sup>***</sup>        | 18.34 <sup>***</sup> | 7.91 <sup>***</sup>   | 0.11                  | 16.39 <sup>***</sup> | 9.32 <sup>***</sup>   | 25.83 <sup>***</sup>        | 18.33 <sup>***</sup> | 2.19 <sup>*</sup>     | -2.54 <sup>*</sup>    | 14.01 <sup>***</sup> | 7.89 <sup>***</sup>  | 7.7 <sup>***</sup>   | 7.7 <sup>***</sup>   | 17.25 <sup>***</sup> | 16.76 <sup>***</sup> | 12.47 <sup>***</sup> | 11.26 <sup>***</sup> |

1 \*\*\* denote significant differences from zero at 0.5 and 0.1 levels probability, respectively.  
12 C= first, second and combined analysis respectively. MP and BP mid and better parent respectively.

**Table (8): Percentage of heterosis over both mid - parent and better parent for studied traits.**

| Table (8): Percentage of heterosis over both mid - parent and better parent for studied traits. |                               |         |                |         |         |          |                |          |                |          |                            |          |                |          |                |         |         |         |                |    |                          |    |    |    |                |    |                |    |    |    |
|-------------------------------------------------------------------------------------------------|-------------------------------|---------|----------------|---------|---------|----------|----------------|----------|----------------|----------|----------------------------|----------|----------------|----------|----------------|---------|---------|---------|----------------|----|--------------------------|----|----|----|----------------|----|----------------|----|----|----|
| Number of grains per spike                                                                      |                               |         |                |         |         |          |                |          |                |          |                            |          |                |          |                |         |         |         |                |    |                          |    |    |    |                |    |                |    |    |    |
| 1000 - kernel weight (g)                                                                        |                               |         |                |         |         |          |                |          |                |          |                            |          |                |          |                |         |         |         |                |    |                          |    |    |    |                |    |                |    |    |    |
| Crosses                                                                                         | Number of spikelets per spike |         |                |         |         |          |                |          |                |          | Number of grains per spike |          |                |          |                |         |         |         |                |    | 1000 - kernel weight (g) |    |    |    |                |    |                |    |    |    |
|                                                                                                 | S <sub>1</sub>                |         | S <sub>2</sub> |         | C       |          | S <sub>1</sub> |          | S <sub>2</sub> |          | C                          |          | S <sub>1</sub> |          | S <sub>2</sub> |         | C       |         | S <sub>1</sub> |    | S <sub>2</sub>           |    | C  |    | S <sub>1</sub> |    | S <sub>2</sub> |    | C  |    |
|                                                                                                 | MP                            | BP      | MP             | BP      | MP      | BP       | MP             | BP       | MP             | BP       | MP                         | BP       | MP             | BP       | MP             | BP      | MP      | BP      | MP             | BP | MP                       | BP | MP | BP | MP             | BP | MP             | BP | MP | BP |
| 1X2                                                                                             | -1.91*                        | -3.01** | -0.31          | -0.74*  | -1.11** | -18.75** | 17.66**        | 4.98*    | 1.52           | 15.57**  | 9.59**                     | -3.68    | -2.27          | -3.68    | 14.69**        | 9.39**  | 6.21**  | 2.85    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 1X3                                                                                             | -1.28*                        | -1.85*  | 1.78*          | -0.17   | 0.25    | -1.01**  | 0.74           | 12.74**  | 6.33**         | 8.27**   | 3.53                       | 9.23**   | 9.23**         | 9.11**   | 4.66*          | -0.51   | 6.94**  | 4.30*   |                |    |                          |    |    |    |                |    |                |    |    |    |
| 1X4                                                                                             | 1.65*                         | -0.99*  | 2.73**         | 2.04*   | 2.19**  | 0.52     | -20**          | 13.33**  | 8.32**         | -3.33    | -8.34**                    | 1.21     | 1.17           | 1.17     | 7.09**         | 2.69    | 4.15**  | 1.93    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 1X5                                                                                             | 5.51**                        | 2.3*    | -0.08          | -3.21** | 2.71**  | -0.45    | -13.25**       | -3.19    | -13.3**        | -8.22**  | -15.97**                   | 2.94     | 10.34**        | 10.03**  | 1.22           | -4.16*  | 5.88**  | 2.93    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 1X6                                                                                             | -1.7*                         | -2.59** | 7.65**         | 6.36**  | 2.97**  | 1.88**   | -7.6**         | 16.47**  | 15.32**        | 1.44     | -1.84                      | 11.28**  | 10.63**        | 10.63**  | 14.86**        | 12.23** | 13.07** | 11.44** |                |    |                          |    |    |    |                |    |                |    |    |    |
| 1X7                                                                                             | 2.41**                        | 1.66*   | 3.28**         | 1.72**  | 2.84**  | 1.69**   | -13.59**       | 18.28**  | 16.42**        | 3.34     | 0.97                       | -0.87    | -2.09          | -4.52*   | 12.15**        | 8.36**  | 5.03**  | 1.92    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 1X8                                                                                             | 3.88**                        | 3.16**  | 11.01**        | 9.92**  | 7.44**  | 6.54**   | -11.6**        | 4.23*    | 2.2            | 0.01     | -4.66                      | -0.87    | -2.09          | -4.52*   | 12.15**        | 8.36**  | 5.03**  | 1.92    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 1X9                                                                                             | -0.62*                        | -1.27*  | 0.75*          | 0.44    | 0.06    | -0.41    | -4.2           | -11.52** | -0.06          | -2.65    | -7.53**                    | 3.8*     | -2.09          | -4.52*   | 12.15**        | 8.36**  | 5.03**  | 1.92    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 2X3                                                                                             | 4.87**                        | 3.1**   | 3.95**         | 2.39**  | 4.41**  | 2.74**   | -3.46          | -12.42** | -0.06          | -2.65    | -11.84**                   | -1.35    | -2.82          | -2.82    | -4.59**        | -5.11*  | -2.97   | -3.96*  |                |    |                          |    |    |    |                |    |                |    |    |    |
| 2X4                                                                                             | 0.08                          | -3.58** | 2.07**         | 0.88*   | 1.07**  | -1.35**  | -4.09          | -15.86** | -0.44          | 1.99     | -8.53**                    | -0.08    | -0.08          | -3.64    | 4.75**         | 3.94*   | 5.79**  | 4.37*   |                |    |                          |    |    |    |                |    |                |    |    |    |
| 2X5                                                                                             | 4.11**                        | -0.16   | 5.78**         | 2.92**  | 4.94**  | 1.38**   | 6.72**         | -2.74    | 8.05**         | -2.75    | -8.82**                    | 6.83**   | 8**            | 4.8*     | 8.71**         | 6.04**  | 8.35**  | 5.93**  |                |    |                          |    |    |    |                |    |                |    |    |    |
| 2X6                                                                                             | 4.43**                        | 2.33*   | 4.34**         | 2.64**  | 4.38**  | 2.48**   | -15.04**       | 12.88**  | 12.65**        | -0.47    | -8.08**                    | 8**      | 4.66*          | 2.64     | -0.59          | -1.23   | 2.03    | 0.70    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 2X7                                                                                             | 3.63**                        | 3.22**  | 3.4**          | 2.28*   | 3.51**  | 2.75**   | -13.83**       | 12.65**  | 7.39**         | 3.68     | -3.5                       | 2.94     | 4.66*          | 1.85     | 4.43*          | 3.06    | 3.69*   | 2.45    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 2X8                                                                                             | -1.98*                        | -2.45** | 4.69**         | 3.22**  | 1.35**  | 0.38     | -5.29*         | -14.39** | 20.1**         | 7.92**   | 0.67                       | -0.81    | -0.81          | -0.86    | 7.02**         | 6.06**  | 3.10    | 2.60    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 2X9                                                                                             | -1.76*                        | -3.5**  | 10.03**        | 9.83**  | 4.13**  | 3.16**   | -2             | 14.52**  | 3.54           | 6.26**   | -0.98                      | -13.12** | -13.12**       | -17.03** | 6.38**         | -2.84   | 5.40**  | -0.29   |                |    |                          |    |    |    |                |    |                |    |    |    |
| 3X4                                                                                             | 7.86**                        | 5.66**  | 9.66**         | 6.84**  | 8.76**  | 6.25**   | -21.89**       | -4.35*   | -9.49**        | -13.12** | -17.03**                   | 4.42*    | 9.37**         | 8.98**   | 0.51           | 0.09    | 4.94**  | 4.53*   |                |    |                          |    |    |    |                |    |                |    |    |    |
| 3X5                                                                                             | 10.07**                       | 7.32**  | 0.25           | -1.00*  | 5.16**  | 3.16**   | -22.53**       | 2.55     | 1.26           | -10**    | -12.19**                   | 9.37**   | 1.78           | 1.31     | 7.42**         | 4.41*   | 4.60**  | 2.86    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 3X6                                                                                             | 4.05**                        | 3.7**   | 3.44**         | 0.25    | 3.74**  | 1.97**   | -22.53**       | 2.55     | 1.26           | -10**    | -12.19**                   | 9.37**   | 1.78           | 1.31     | 7.42**         | 4.41*   | 4.60**  | 2.86    |                |    |                          |    |    |    |                |    |                |    |    |    |
| 3X7                                                                                             | 6.36**                        | 4.98**  | 8.72**         | 8.25**  | 7.54**  | 6.61**   | -19.22**       | 12.8**   | 5.44*          | -3.21    | -8.31**                    | 1.78     | 1.31           | 1.31     | 7.42**         | 4.41*   | 4.60**  | 2.86    |                |    |                          |    |    |    |                |    |                |    |    |    |

\* and \*\* denote significant differences from zero at 0.5 and 0.1 levels probability, respectively.  
S1, S2 C= first, second mid combined analysis respectively. MP and BP mid and better parent respectively.

**Table (8): Percentage of heterosis over both mid - parent and better parent for studied traits.**

| Table (8): Percentage of heterosis over both mid - parent and better parent for studied traits. |                |         |         |         |         |         |          |          |         |         |                |         |          |          |                            |         |         |         |      |      |                |      |      |      |      |                |      |      |      |  |   |  |  |  |  |
|-------------------------------------------------------------------------------------------------|----------------|---------|---------|---------|---------|---------|----------|----------|---------|---------|----------------|---------|----------|----------|----------------------------|---------|---------|---------|------|------|----------------|------|------|------|------|----------------|------|------|------|--|---|--|--|--|--|
| Number of spikelets per spike                                                                   |                |         |         |         |         |         |          |          |         |         |                |         |          |          | Number of grains per spike |         |         |         |      |      |                |      |      |      |      |                |      |      |      |  |   |  |  |  |  |
| Crosses                                                                                         | S <sub>1</sub> |         |         |         |         | C       |          |          |         |         | S <sub>2</sub> |         |          |          |                            | C       |         |         |      |      | S <sub>1</sub> |      |      |      |      | S <sub>2</sub> |      |      |      |  | C |  |  |  |  |
|                                                                                                 | MP             | BP      | MP      | BP      | MP      | MP      | BP       | MP       | BP      | MP      | MP             | BP      | MP       | BP       | MP                         | MP      | BP      | MP      | BP   | MP   | MP             | BP   | MP   | MP   | BP   | MP             | BP   | MP   | BP   |  |   |  |  |  |  |
| 3X8                                                                                             | 6.46**         | 4.03**  | 10.22** | 4.51**  | 8.34**  | 4.27**  | -12.45** | -12.8**  | 18.36** | 27.25** | 4.69*          | -6.10** | 7.40**   | 2.78     | 2.67                       | 2.27    | -3.73*  | 4.0     | 1.0  | 1.0  | 1.0            | 1.0  | 1.0  | 1.0  | 1.0  | 1.0            | 1.0  | 1.0  | 1.0  |  |   |  |  |  |  |
| 3X9                                                                                             | 0.77*          | -2.22** | 5.33**  | -0.52*  | 3.05**  | -1.37** | -16.9**  | -21.03** | 0.58    | 4.69*   | -0.55          | -14.4** | -12.47** | -10.22** | 5.61**                     | 2.88    | 2.81    | 19.87** | 10.0 | 10.0 | 10.0           | 10.0 | 10.0 | 10.0 | 10.0 | 10.0           | 10.0 | 10.0 | 10.0 |  |   |  |  |  |  |
| 4X5                                                                                             | 16.28**        | 16.28** | 4.07**  | -3.35** | 10.17** | 6.46**  | -24.39** | -24.54** | -0.55   | 11.73** | 2.16           | 2.98    | 1.63     | 1.63     | 4.33*                      | 3.87*   | -1.39   | 19.87** | 2.6  | 2.6  | 2.6            | 2.6  | 2.6  | 2.6  | 2.6  | 2.6            | 2.6  | 2.6  | 2.6  |  |   |  |  |  |  |
| 4X6                                                                                             | 11.6**         | 4.41**  | 6.05**  | 1*      | 8.82**  | 2.70**  | -5.76*   | -3.42*   | 11.73** | 11.73** | 2.16           | 2.98    | 1.63     | 1.63     | 4.33*                      | 3.87*   | -1.39   | 19.87** | 2.6  | 2.6  | 2.6            | 2.6  | 2.6  | 2.6  | 2.6  | 2.6            | 2.6  | 2.6  | 2.6  |  |   |  |  |  |  |
| 4X7                                                                                             | 17.24**        | 12.88** | 17.39** | 16.99** | 17.31** | 14.93** | -15.61** | -15.75** | 12.29** | 12.29** | 8.36**         | 1.66    | 12.03**  | 10.31**  | -0.23                      | -0.76   | 6.58**  | 17.82** | 10.0 | 10.0 | 10.0           | 10.0 | 10.0 | 10.0 | 10.0 | 10.0           | 10.0 | 10.0 | 10.0 |  |   |  |  |  |  |
| 4X8                                                                                             | 17**           | 9.9**   | 9.7**   | 8.96**  | 13.35** | 9.43**  | -29.35** | -31.67** | 14.49** | 14.49** | 11.04**        | -7.43** | 10.31**  | 10.31**  | 3.49*                      | 3       | 17.82** | 10.0    | 10.0 | 10.0 | 10.0           | 10.0 | 10.0 | 10.0 | 10.0 | 10.0           | 10.0 | 10.0 | 10.0 |  |   |  |  |  |  |
| 4X9                                                                                             | 18.9**         | 13.51** | 6.52**  | 6.52**  | 12.71** | 10.01** | -13.77** | -14.97** | 11.17** | 11.17** | 4.34           | -1.3    | -5.31*   | -5.31*   | 2.73                       | 0.13    | 8.21**  | 15.06** | 6.0  | 6.0  | 6.0            | 6.0  | 6.0  | 6.0  | 6.0  | 6.0            | 6.0  | 6.0  | 6.0  |  |   |  |  |  |  |
| 5X6                                                                                             | 4.37**         | 2.05**  | 10.98** | 6.25**  | 7.67**  | 4.15**  | -13.45** | -13.93** | -3.17   | -9.46** | -10.62**       | -7.12** | -12.78** | -12.78** | 8.62**                     | 6.84**  | -2.86   | 15.06** | 4.0  | 4.0  | 4.0            | 4.0  | 4.0  | 4.0  | 4.0  | 4.0            | 4.0  | 4.0  | 4.0  |  |   |  |  |  |  |
| 5X7                                                                                             | 1.43*          | -2.35** | 0.25    | -1.41*  | 0.84**  | -1.88** | -22.32** | -23.75** | 11.38** | 11.38** | -1.54          | -5.47*  | -13.14** | -13.14** | 12.54**                    | 10.63** | 3.35*   | 9.4**   | 2.0  | 2.0  | 2.0            | 2.0  | 2.0  | 2.0  | 2.0  | 2.0            | 2.0  | 2.0  | 2.0  |  |   |  |  |  |  |
| 5X8                                                                                             | 4.34**         | 0.49    | 1.6*    | -2.5*   | 2.97**  | 1.1*    | -20.48** | -21.75** | 3.41    | 3.41    | -3.76*         | -8.53** | -13.75** | -13.75** | -5.03**                    | -9.35** | 9.4**   | 9.4**   | 0.0  | 0.0  | 0.0            | 0.0  | 0.0  | 0.0  | 0.0  | 0.0            | 0.0  | 0.0  | 0.0  |  |   |  |  |  |  |
| 5X9                                                                                             | 2.52**         | 0       | 0.51*   | -2.37** | 1.51**  | -1.18** | -18.79** | -19.21** | 2.18    | 2.18    | -3.37          | -8.30** | -11.29** | -11.29** | 8.75**                     | 8.63**  | 7.64**  | 7.64**  | 4.0  | 4.0  | 4.0            | 4.0  | 4.0  | 4.0  | 4.0  | 4.0            | 4.0  | 4.0  | 4.0  |  |   |  |  |  |  |
| 6X7                                                                                             | 2.22**         | 0.57    | 3.32**  | 0.56*   | 2.77**  | 0.56    | -18.79** | -19.21** | 2.18    | 2.18    | -3.37          | -8.30** | -11.29** | -11.29** | 8.75**                     | 8.63**  | 7.64**  | 7.64**  | 4.0  | 4.0  | 4.0            | 4.0  | 4.0  | 4.0  | 4.0  | 4.0            | 4.0  | 4.0  | 4.0  |  |   |  |  |  |  |
| 6X8                                                                                             | -2.6**         | -4.1**  | -0.68*  | -0.9*   | -1.64** | -2.50** | -8.47**  | -9.43**  | 11.11** | 11.11** | 8.05**         | 1.32    | -0.69    | -0.69    | 6.73**                     | 3.6     | 8.22**  | 8.22**  | 5.0  | 5.0  | 5.0            | 5.0  | 5.0  | 5.0  | 5.0  | 5.0            | 5.0  | 5.0  | 5.0  |  |   |  |  |  |  |
| 6X9                                                                                             | -1.13*         | -1.37*  | 5.25**  | 3.67**  | 2.06**  | 1.15**  | -8.47**  | -9.43**  | 11.11** | 11.11** | 8.05**         | 1.32    | -0.69    | -0.69    | 6.73**                     | 3.6     | 8.22**  | 8.22**  | 5.0  | 5.0  | 5.0            | 5.0  | 5.0  | 5.0  | 5.0  | 5.0            | 5.0  | 5.0  | 5.0  |  |   |  |  |  |  |
| 7X8                                                                                             | 0.36           | 0.28    | 10.17** | 7.46**  | 5.26**  | 3.87**  | -19.06** | -21.61** | 20.72** | 20.72** | 20.1**         | 0.83    | -0.75    | -0.75    | 5.97**                     | 5.89*   | -0.76   | 2.4     | 2.4  | 2.4  | 2.4            | 2.4  | 2.4  | 2.4  | 2.4  | 2.4            | 2.4  | 2.4  | 2.4  |  |   |  |  |  |  |
| 7X9                                                                                             | -2.71**        | -4.05** | 0.21    | -1.03*  | -1.25** | -2.54** | -25.77** | -26.92** | 11.27** | 11.27** | 8.1**          | -7.25** | -9.41**  | -9.41**  | 4.59*                      | 1.42    | -7.18** | -7.18** | 1.0  | 1.0  | 1.0            | 1.0  | 1.0  | 1.0  | 1.0  | 1.0            | 1.0  | 1.0  | 1.0  |  |   |  |  |  |  |
| 8X9                                                                                             | 3.82**         | 2.47**  | 6.36**  | 5       | 5.09**  | 3.73**  | 5.52*    | 10.87**  | 8.45**  | 8.45**  | 4.71           | 6.98**  | 7.79**   | 7.79**   | -2.71                      | -5.58*  | -7.18** | -7.18** | 1.0  | 1.0  | 1.0            | 1.0  | 1.0  | 1.0  | 1.0  | 1.0            | 1.0  | 1.0  | 1.0  |  |   |  |  |  |  |

\* and \*\* denote significant differences from zero at 0.5 and 0.1 levels probability, respectively.

S1, S2 C= first, second and combined analysis respectively. MP and BP mid and better parent respectively.

**Table (8): Percentage of heterosis over both mid - parent and better parent for studied traits.**

| Table (8): Percentage of heterosis over both mid - parent and better parent for studied traits. |                           |          |          |          |          |          |         |         |          |          |                |          |          |          |          |                           |          |         |         |         |                |    |    |    |    |                |    |    |    |    |  |
|-------------------------------------------------------------------------------------------------|---------------------------|----------|----------|----------|----------|----------|---------|---------|----------|----------|----------------|----------|----------|----------|----------|---------------------------|----------|---------|---------|---------|----------------|----|----|----|----|----------------|----|----|----|----|--|
| Crosses                                                                                         | Grain yield per plant (g) |          |          |          |          |          |         |         |          |          |                |          |          |          |          | Straw yield per plant (g) |          |         |         |         |                |    |    |    |    |                |    |    |    |    |  |
|                                                                                                 | S <sub>1</sub>            |          |          |          |          | C        |         |         |          |          | S <sub>2</sub> |          |          |          |          | C                         |          |         |         |         | S <sub>1</sub> |    |    |    |    | S <sub>2</sub> |    |    |    |    |  |
|                                                                                                 | MP                        | BP       | MP       | BP       | MP       | MP       | BP      | MP      | BP       | MP       | MP             | BP       | MP       | BP       | MP       | MP                        | BP       | MP      | BP      | MP      | MP             | BP | MP | BP | MP | BP             | MP | BP | MP | BP |  |
| 1X2                                                                                             | -2.32                     | 2.23     | 25.46**  | 14.37**  | 11.57**  | 8.30*    | 81.02** | 3.66    | -20.57** | -9.87*   | -44.96**       | -13.41** | -19.92** | -3.57**  | -25.40** | -31.25**                  | 18.33**  | -6.48** | -7.86** | -6.31** |                |    |    |    |    |                |    |    |    |    |  |
| 1X3                                                                                             | 4.81                      | -12.60*  | 19.5**   | 6.89*    | 12.15**  | -2.85    | 18.13** | 2.01    | -44.96** | -41.86** | -31.24**       | 5.23     | -1.63    | -16.98** | -20**    | -5.26**                   | 32.14**  | -6.29** | -6.52** | -6.29** |                |    |    |    |    |                |    |    |    |    |  |
| 1X4                                                                                             | 4.51                      | -3.96    | 14.52**  | 12.6**   | 9.51**   | 4.32     | 47.07** | 27.98** | -36.57** | -31.24** | 5.23           | -1.63    | -16.98** | -20**    | -5.26**  | 32.14**                   | -6.29**  | -6.52** | -6.29** | -6.29** |                |    |    |    |    |                |    |    |    |    |  |
| 1X5                                                                                             | -23.07**                  | -37.30** | 18.8**   | 15.15**  | -2.13    | -11.07** | 53.89** | 43.99** | 59.46**  | 11.20**  | 56.67**        | 27.59**  | -27.58** | -32.25** | -25.42** | -32.25**                  | -11.47** | -4.68*  | -5.60** | -4.83** |                |    |    |    |    |                |    |    |    |    |  |
| 1X6                                                                                             | 12.04**                   | 0.07     | 5.82*    | 5.82*    | 8.93**   | 2.94     | 88.29** | 77.42** | -1.37    | 4.85     | 43.46**        | 41.13**  | -13.72** | -25.42** | -25.42** | -25.42**                  | 5.26**   | 1.27    | -2.15*  | 1.19    |                |    |    |    |    |                |    |    |    |    |  |
| 1X7                                                                                             | 5.01                      | -5.40    | 23.77**  | 21.75**  | 14.39**  | 8.17*    | 44.48** | 25.27** | -20.10** | -9.73*   | 6.70           | 12.19**  | 7.77     | -16.60** | -15.09** | -15.09**                  | 21.15**  | 2.72*   | -1.59   | 2.52*   |                |    |    |    |    |                |    |    |    |    |  |
| 1X8                                                                                             | 8.73                      | 1.82     | 47.93**  | 46.83**  | 28.33**  | 24.32**  | 43.63** | 20.53** | -30.22** | -21.81** | 6.70           | 12.19**  | 7.77     | -16.60** | -15.09** | -15.09**                  | 21.15**  | 2.72*   | -1.59   | 2.52*   |                |    |    |    |    |                |    |    |    |    |  |
| 1X9                                                                                             | -8.36                     | -20.20** | 24.2**   | 14.65**  | 7.92*    | -2.77    | 43.27** | 28.56** | -17.09** | -11.44** | 13.09**        | 8.56*    | 47.52**  | -26.66** | -31.25** | -26.23**                  | 0.45     | -1.15   | 0.74    |         |                |    |    |    |    |                |    |    |    |    |  |
| 2X3                                                                                             | -18.30**                  | -26.43** | -28.43** | -29.92** | -23.36** | -28.17** | 52.49** | 23.14** | 43.51**  | 71.9**   | 47.50**        | 40.89**  | 38.76**  | -29.30** | -35.93** | -1.72*                    | 6.84**   | -1.03   | 7.13**  |         |                |    |    |    |    |                |    |    |    |    |  |
| 2X4                                                                                             | -11.49*                   | -13.69** | 5.37*    | -2.45    | -3.06    | -8.07*   | 68.80** | 37.26** | 12.99**  | 40.26**  | 65.21**        | 65.29**  | 63.29**  | -23.80** | -23.80** | -23.80**                  | -7.57**  | 0.93    | -0.51   | 0.21    |                |    |    |    |    |                |    |    |    |    |  |
| 2X5                                                                                             | -5.07                     | 15.007** | 16.94**  | 9.76**   | 5.93     | -2.62    | 77.41** | 54.09** | 53.02**  | 76.5**   | 65.21**        | 65.29**  | 63.29**  | -23.80** | -23.80** | -23.80**                  | -7.57**  | 0.93    | -0.51   | 0.21    |                |    |    |    |    |                |    |    |    |    |  |
| 2X6                                                                                             | 5.26                      | 2.80     | 27.2**   | 21.35**  | 16.23**  | 12.07**  | 63.76** | 43.14** | -41.56** | -37.83** | 11.10**        | 2.65     | -14.75** | -18.75** | -18.75** | -18.75**                  | 27.42**  | -2.06   | -6.66** | -1.80   |                |    |    |    |    |                |    |    |    |    |  |
| 2X7                                                                                             | -5.82                     | -6.15    | 26.27**  | 16.86**  | 10.22**  | 5.35     | 66.61** | 35.03** | -60.01** | -48.04** | 3.30           | -6.50    | 19.92**  | -17.85** | -28.12** | -28.12**                  | 12.28**  | -0.39   | -5.19** | -0.16   |                |    |    |    |    |                |    |    |    |    |  |
| 2X8                                                                                             | -3.45                     | -7.69    | 26.53**  | 16.13**  | 11.54**  | 4.22     | 47.56** | 16.30** | -4.06    | 23.54**  | 21.75**        | 19.92**  | 11.13*   | -18.33** | -12.50** | -12.50**                  | 8.33**   | 2.89*   | -2.53** | 2.78**  |                |    |    |    |    |                |    |    |    |    |  |
| 2X9                                                                                             | -14.85**                  | -17.87** | 6.41**   | 4.95     | -4.22    | -6.46    | 36.90** | 14.45** | -11.72** | 7.81     | 12.59**        | 11.13*   | 8.22     | -18.51** | -22.80** | -22.80**                  | 12.73**  | 6.34**  | 0.26    | 6.37**  |                |    |    |    |    |                |    |    |    |    |  |
| 3X4                                                                                             | -11.45*                   | -20.33** | 9.98**   | -0.13    | -0.73    | -10.33** | 32.26** | 31.08** | -16.7**  | -14.63** | 7.78*          | 8.22     | 36.37**  | -20.30** | -24.19** | -24.19**                  | 0        | -3.53*  | -4.54** | -3.52** |                |    |    |    |    |                |    |    |    |    |  |
| 3X5                                                                                             | -24.44**                  | -26.50** | 4.57*    | -3.75    | -9.93**  | -15.12** | 29.19** | 18.50** | 8.39*    | 54.24**  | 18.79**        | 18.79**  | 36.37**  | -20.30** | -24.19** | -24.19**                  | 0        | -3.53*  | -4.54** | -3.52** |                |    |    |    |    |                |    |    |    |    |  |
| 3X6                                                                                             | -10.14*                   | -15.71** | 18.46**  | 10.78**  | 4.16     | -2.46    | 15.89** | 5.58    | -24.94** | -15.45** | -4.52          | -4.93    | 36.37**  | -20.30** | -24.19** | -24.19**                  | 0        | -3.53*  | -4.54** | -3.52** |                |    |    |    |    |                |    |    |    |    |  |
| 3X7                                                                                             | -24.44**                  | -30.83** | 4.49*    | -5.14    | -9.97**  | -17.98** | 32.87** | 32.24** | -23.33** | -18.26** | 4.77           | 6.99     | 36.37**  | -20.30** | -24.19** | -24.19**                  | 0        | -3.53*  | -4.54** | -3.52** |                |    |    |    |    |                |    |    |    |    |  |

and \*\* denote significant differences from zero at 0.5 and 0.1 levels probability, respectively.  
 , S2 C= first, second and combined analysis respectively. MP and BP mid and better parent respectively.