EXPERIMENTAL FINDINGS

The present studies on "Breeding behaviour of yield and its components in barley" were undertaken using the partial diallel technique of Kempthorne and Curnow (1961). The results are presented in the following paragraphs:

1. Analysis of variance:

The analysis of variance for sixteen quantitative characters is given in Table 1.

As is evident the variation due to block differences was significant for a large number of characters. All the 135 progenies included in the experiment differed significantly amongst themselves for all the characters. On partitioning the variation among different sets of populations significant differences were eminent among the parents and within F1 and F2 progenies.

Compared to the parents and crosses significant variation was observed but for four traits viz., heading days, grain development period, area of flag leaf and protein content. F1 hybrids also differed significantly from their F2 populations for all the characters except flag leaf area.

2. Variability among the parents:

The variability among the fifteen parents was exhibited in terms of range, phenotypic and genotypic variances, and phenotypic and genotypic coefficient of variations. The results are presented in Table 2.
Though variation among the parents was found significant for all the characters excepting peduncle length, however, the magnitude of variation differed from character to character. In terms of range the variation was maximum for extrusion of peduncle, kernel colour, and low for heading days, awn length, ear length, and protein content. It was observed medium for rest of the characters.

The variability among the parents for each of the character was also calculated in terms of phenotypic and genotypic variances. For better comparison of different characters coefficients of variations were also worked out. While examining the phenotypic coefficient of variation, the characters—kernel colour (77.25%), extrusion of peduncle (64.75%) and flag leaf area (48.99%) showed maximum variability, followed by number of grains of main spike (44.11%), grain weight of the main spike (41.67%) and number of ears per plant (34.49%). Other characters exhibited minimum phenotypic variability. Similar to phenotypic coefficient of variation, genotypic coefficient of variation was observed maximum for kernel colour (77.25%) followed by extrusion of peduncle (60.85%), number of grains on main spike (43.29%) and grain weight of main spike (40.55%). Other characters exhibited medium to low genotypic variability. The phenotypic and genotypic variability in protein content was poor.

3. Combining ability variance:

The combining ability variance was partitioned into general and specific combining ability variances as given in Table 3.
Variation due to the general combining ability effect was found to be highly significant for all the characters in both $F_1$ and $F_2$ populations. Except for grain development period, awn length and number of ears per plant in $F_1$ and awn length, number of ears per plant, number of grains per plant and grain yield per plant in $F_2$, the specific combining ability variance was significant in both the populations.

Magnitude of gca was higher than sca for all the characters in $F_1$ and $F_2$ as is evident from gca : sca ratio which ranged from 2.48:1 to 36.25:1 in $F_1$ and from 4.33:1 to 83.38:1 in $F_2$. In both the generations highest value for the ratio was obtained for kernel colour. The ratio of gca:sca was almost similar for both the generations excepting that it was higher in $F_1$ for peduncle length, extrusion, heading days and grain development period. For kernel colour, yield and its contributory characters and also for protein content, it was appreciably high in $F_2$.

Error variance showing role of environment for the expression of characters was almost similar in both $F_1$ and $F_2$ excepting that it was high in $F_2$ for plant height, heading days, grain development period, kernel colour, number of grains in main spike, and 1000-grain weight.

Estimates of gca ($6^2g$) and sca ($6^2s$) variances were also worked out by the expectation equations from the observed mean sum of squares. The additive component ($6^2g$) was found higher in $F_1$ than non-additive ($6^2s$) for peduncle length, extrusion, heading days, grain development period, awn length, kernel colour,
flag leaf area, number of ears per plant, number of grains on the main spike, grain yield of the main spike and protein content. On the other hand, for plant height, ear length, 1000-grain weight and grain yield per plant, non-additive \((6^2a)\) component was greater than additive \((6^2g)\) one.

In \(F_2\) also the picture was much more similar excepting that \(6^2g\) was high for ear-length, 1000 grain weight and grain yield per plant. Non-additive component \((6^2s)\) was higher for peduncle length, extrusion and protein content.

4. General combining ability:

General combining ability effects for each of the fifteen varieties, involved in the crosses, were estimated for sixteen characters on the basis of the performance of \(F_1\) and \(F_2\) populations. The mean performance of these populations are given in Appendix 1 to Appendix 3. The estimates of general combining ability values are given in Table 4.

The estimates of general combining ability effects were found significant for all the characters. The best combiners were evaluated on the basis of magnitude and direction of combining ability effects in \(F_1\) and \(F_2\) and their corresponding mean performance. The negative estimates were considered superior for plant height, heading days and kernel colour.

General combining ability effects were high in \(F_1\) for nine traits viz., extrusion, awn length, ear length, number of ears per plant, number of grains on main spike, number of grains per plant, grain yield of main spike, 1000-grain weight and protein content.
Best combiners for different traits, given in Table 5, are detailed below:

(1) **Plant height:** In F₁, Numar was found superior followed by AQ 769, DG 2, Glacier and Majwah. In F₂ Numar remained superior followed by DG 2, Majwah, AQ 769. Considering the mean performance and the magnitudes in F₁ and F₂ together Numar, DG 2, AQ 769 and Majwah were found good combiners for this trait.

(2) **Peduncle length:** In F₁, Conquest was found best followed by REB 614, Ratna, EB 921 and IB 65. In F₂, Conquest remained best followed by Ratna. Considering the overall performance Conquest and Ratna were desirable combiners.

(3) **Extrusion of peduncle:** In F₁, Conquest appeared best followed by REB 614, Ratna and K 1596. In F₂, Conquest retained its superiority followed by Ratna. Other good combiners were Mex.22 and K 1596. Considering the mean performance Conquest, Ratna and K 1596 were good combiners.

(4) **Heading days:** In F₁, K 1596 was found earliest combiner followed by Ratna. Other early combiners were EB 1626, Majwah and Conquest. In F₂, K 1596 was best followed by Ratna. Other good combiners were Conquest and EB 921. On the basis of overall performance K 1596, Ratna and Conquest were good combiners.

(5) **Grain development period:** In F₁, K 1596 scored best followed by Ratna and Numar. In F₂, K 1596 remained best followed by Ratna, Mex-22 and Numar. On the overall basis K 1596, Ratna and Numar were found good combiners.

(6) **Awn length:** In F₁, Ratna had highest value followed by Mex.22 and Clipper. In F₂, Ratna was best followed by REB 614.
Table 5. Best general combiners in $F_1$ and $F_2$ populations in respect of 16 traits in barley

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<th>Characters</th>
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<th>Plant height</th>
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+ Good combiner in $F_1$
++ Good combiner in $F_2$
+++ Good combiner in $F_1$ and $F_2$. 
Clipper, Glacier and K 1596. On the basis of mean performance, Ratna was superior followed by Clipper. Other good combiners for this trait were REB 614, Glacier and K 1596.

(7) Ear length: In F₁, highest value was obtained for EB 2342 followed by REB 614, Clipper, Ratna and Conquest. In F₂, EB 2342 remained superior followed by Ratna, Clipper, REB 614 and Conquest. Considering the mean performance, EB 2342 was best combiner for this trait followed by Ratna, Clipper, REB 614 and Conquest.

(8) Kernel colour: In F₁ combinations, Glacier had highest (negative) value followed by IB 65, K 1596, Mex.22 and Clipper. In F₂, Glacier and Mex.22 were best parents followed by IB 65, REB 614, EB 2342, K 1596 and EB 921. On the basis of overall performance Glacier and IB 65 were best combiners followed by Mex.22 and K 1596.

(9) Flag leaf area: In F₁ combinations, superiority was observed in EB 1626 followed by Ratna, Numar, REB 614 and Mex.22. In F₂, EB 1626 had highest value followed by Numar and Ratna. Other good combiners were REB 614 and Mex.22. On the overall basis EB 1626 was best followed by Numar and Ratna. Other good combiners for this trait were REB 614 and Mex.22.

(10) Number of ears per plant: In F₁, highest value was observed for AQ 769 followed by Numar and Ratna. In F₂, superiority for this character was observed in EB 2342 followed by REB 614, EB 1626, AQ 769 and Clipper. Considering the mean performance AQ 769 was the good combiner.

(11) Number of grains on the main spike: In F₁, high value was
obtained for Mex.22, followed by Ratna, DG 2, Majwah, IB 65, K 1596, Glacier and Conquest. In F2, Ratna was found best followed by IB 65, K 1596, Mex. 22, Conquest, Majwah and DG 2. On the basis of overall performance, Ratna, was found the best followed by IB 65, Mex.22, K 1596, Majwah and DG 2.

(12) *Number of grains per plant:* In F1, Majwah had the highest value followed by K 1596 and Ratna. Other good combiners were DG 2 and Numar. In F2, Ratna was best followed by K 1596, Mex.22 and Numar. Considering the overall performance, Ratna remained best followed by K 1596 and Numar.

(13) *1000-grain weight:* In F1 combinations, highest value was obtained from REB 614 followed by EB 921, EB 2342, AQ 769 and Clipper. In F2, EB 921 was the top parent followed by EB 2342, REB 614, K 1596 and Clipper. Considering the overall performance EB 921 was best combiner followed by REB 614, EB 2342, Clipper and K 1596.

(14) *Grain yield of the main spike:* In F1, highest value was obtained from Ratna followed by K 1596, DG 2, Mex.22, IB 65 and Glacier. In F2, Ratna was again best followed by K 1596, Mex.22, IB 65 and Conquest. On the basis of overall performance Ratna, K 1596, Mex.22 and IB 65 were good combiners.

(15) *Grain yield per plant:* In F1, DG 2 was best combiner. Other good combiners were K 1596, Ratna, Numar and Majwah. In F2, Ratna gave best performance followed by K 1596 and Mex.22. Other good parents were Numar and EB 2342. On the overall basis Ratna, K 1596 and Numar were found superior combiners.

(16) *Protein content:* In F1, best combining ability was exhibited
by EB 2342 followed by REB 614. Other good combiners were EB 921, AQ 769 and Conquest. In F2, AQ 769 was best followed by REB 614, Conquest, DG2, EB 921 and EB 2342. On the basis of overall performance REB 614, EB 2342, AQ 769, Conquest and EB 921 were found to be good combiners for protein content.

It is evident from these findings that all the parents included in the study were found superior combiners for different traits. However, none of them exhibited superiority in respect of all the characters.

5. Hybrid vigour and inbreeding depression:

Hybrid vigour in F1 and inbreeding depression in F2 was studied in all the 60 crosses. The percentage of increase or decrease in the performance of F1 over (i) the mid-parent, (ii) superior parent in the cross combination (iii) best variety for the particular character included in the experiment has been estimated. The inbreeding depression in F2 over F1 was also calculated.

(1) Plant height: Out of 60 crosses, 44 crosses showed increase over the taller parent, which ranged from 0.9% (11x15) to 22.7% (1x11). The maximum heterosis was exhibited by the cross 1x11 (22.7%), followed by 7x11 (22.0%), 2x13 (21.5%) and 2x6 (21.3%).

Increase over mid-parent was recorded in all the crosses except in 6x12 (-2.4%) and ranged from 1.8% (4x12) to 88.6% (6x15). The maximum increase was observed in cross 6x15 (88.6%) followed by 9x15 (61.8%) and 7x15 (45.6%).

Only 12 crosses were found superior to the best
variety. The maximum increase was recorded in the cross 7x12 (19.1%) followed by 7x11 (6.6%) and 1x10 (4.3%).

Inbreeding depression was exhibited in F₂ population of the 51 crosses and the range was recorded from -0.3% to -21.8%. The maximum increase was observed in 6x12 (10.6%) followed by 8x14 (5.3%) and 3x9 (4.4%).

(2) Grain development period: Heterosis over superior parent ranged from -34.7% (2x7) to 4.6% (9x14). Only four crosses viz., 9x14 (4.6%), 7x14 (4.3%), 6x10 (1.8%) and 10x14 (0.7%) showed increase.

Range of heterosis over mid-parent was from -19.9% (2x8) to 16.2% (3x4). Increase was observed in 24 crosses. Maximum increase was noticed in 3x14 (16.2%) followed by 9x14 (14.7%) and 4x14 (11.8%).

None of the crosses showed increase over the best variety for this trait.

In F₂ inbreeding depression was noticed, ranging from -0.6% (7x15) to -11.4% (5x15) in 30 crosses. Maximum increase was noted in 3x7 (18.5%) followed by 1x12 (16.1%), 4x11 (15.3%) and 5x13 (14.9%).

(3) Awn length: Heterosis for awn length over superior parent, ranged from -17.0% (7x13) to 27.4% (5x12). Maximum heterosis was observed in 5x12 (27.4%) followed by 4x15 (25.6%), 4x14 (22.4%) and 5x14 (22.4%).

Over mid-parent, heterosis ranged from -7.2% (3x9) to 31.2% (5x12). 48 F₁ combinations showed increase over mid-parent. Maximum increase was observed in 5x12 (31.2%) followed
by 2x11 (29.0%), 4x15 (26.3%) and 5x11 (26.3%).

Over best variety, six combinations exhibited positive heterosis. Maximum increase was observed in 1x6 (6.7%) followed by 1x12 (5.1%), 1x10 (4.4%) and 5x12 (3.5%).

In F2, maximum inbreeding depression was noticed in 5x12 (-30.1%) and no depression in 1x7, 7x12 and 10x15 (0.0%). Increase over F1 was observed in 16 crosses. Maximum increase was observed in 5x11 (13.3%) followed by 2x7 (11.9%), 2x10 (11.2%).

Ear length: Increase over superior parent ranging from 0.6% to 32.7% was noticed in 51 combinations. Superior performance was exhibited by 2x6 (32.7%) followed by 2x7 (29.1%), 7x14 (28.7%), 1x11 (22.4%), 7x12 (21.2%) and 2x10 (21.2%).

All the F1 combinations, except 4x8 (-0.0%) and 6x10 (-1.2%), were superior to mid-parent. The range in increase was observed from 1.2% to 38.2%. Maximum increase was observed in 2x10 (38.2%) followed by 2x6 (36.8%), 7x14 (33.2%), 2x9 (31.1%) and 2x7 (30.9%).

Increase over the best variety was observed in 16 crosses. This increase ranged from 0.9% (2x11) to 12.7% (2x10). Among them 2x10 (12.7%) exhibited superior performance followed by 3x12 (11.2%), 1x11 (9.5%) and 4x13 (8.6%).

Inbreeding depression in F2 was evident in 51 combinations. This depression ranged from -1.0% to -18.7%. Increase over F1 was observed in nine F2 populations. Highest increase was noticed in 1x7 (11.6%) followed by 5x14 (8.5%) and 6x10 (7.8%).
(5) **Flag leaf area:** Heterosis over superior parent for flag leaf area, ranged from -62.9% to 116.8%. 16 crosses showed positive heterosis ranging from 2.7% (1x9) to 116.8% (7x11). Superior performance was observed in 7x11 (116.8%) followed by 7x14 (26.2%), 4x10 (19.7%) and 3x9 (19.1%).

Heterosis over mid-parent ranged from -49.1% to 122.7%. Increase was observed in 29 F1 combinations. Maximum increase was noticed in 7x11 (122.7%) followed by 3x11 (52.7%) and 11x15 (40.6%).

Heterosis over best variety was exhibited by only five crosses. Crosses 1x5 (10.1%) and 3x8 (0.8%) exhibited maximum and minimum increase respectively.

Inbreeding depression was observed in 30 F2 populations which ranged from -0.6% (8x15) to -43.4% (7x11). Maximum increase over F1 was shown by 4x12 (106.4%) followed by 1x7 (63.8%), 6x14 (58.6%), 8x14 (57.7%), 3x7 (56.4%) and 5x9 (52.8%).

(6) **Number of ears per plant:** Range of heterosis over superior parent was observed from -49.2% (5x9) to 32.6% (6x15). A set of 25 combinations exhibited positive heterosis. Maximum increase was observed in the cross 6x15 (32.6%) followed by 1x6 (31.9%), 5x12 (31.3%) and 1x12 (29.3%).

Heterosis over mid-parent ranged from -28.9% (5x9) to 54.8% (5x12). A set of 38 combinations exhibited positive heterosis. Maximum increase was observed in 5x12 (54.8%), followed by 7x14 (49.6%), 5x15 (45.5%) and 4x14 (44.7%).

Increase over best variety was noted only in ten
combinations. Crosses 3x11 (25.4%), 9x14 (17.9%) and 1x8 (17.4%) were found superior.

Inbreeding depression was exhibited by 24 F2 populations, the range being from -1.8% (1x11) to -39.4% (1x8). Increase over F1 was maximum in 5x9 (68.1%) followed by 5x10 (66.2%), 5x11 (38.2%), 1x7 (34.9%).

(7) Number of grains in the main spike: Heterosis over better parent was observed from -66.9% (4x10) to 43.1% (8x15). 12 combinations showed positive heterosis. Superior cross-combinations were 8x15 (48.1%), 2x6 (41.4%) and 3x8 (31.5%).

Heterosis over mid parent ranged from -48.1% (4x14) to 52.4% (8x15). 20 combinations expressed positive heterosis. Maximum increase was observed in 8x15 (52.4%) followed by 4x15 (44.1%), 2x6 (41.5%) and 5x15 (37.7%).

Three combinations viz., 1x8 (3.9%), 1x5 (2.5%) and 5x15 (1.7%) showed increase over best variety.

Inbreeding depression in F2 ranged from 1.6% (2x9) to 32.1% (4x9). Increase over F1 ranging from 1.1% (10x14) to 105.5% (5x14) was observed in 41 F2 populations. Other superior combinations were 1x10 (71.4%), 5x11 (69.2%), 4x10 (66.2%) and 7x12 (59.6%).

(8) Number of grains per plant: Heterosis over superior parent ranged from -56.1% (8x12) to 125.6% (5x15). 21 combinations exhibited positive heterosis. Superior combinations were 5x15 (125.6%), 6x15 (106.0%) and 1x8 (89.9%).

Heterosis over mid-parent ranged from -41.3% (8x12) to 127.8% (5x15). 30 combinations showed positive heterosis.
Maximum increase was observed in 5x15 (127.8%) followed by 6x15 (107.0%), 1x8 (97.6%) and 2x6 (78.2%).

Positive heterosis over best variety was observed in ten combinations, maximum increase being observed in 1x8 (89.9%) and minimum in 1x5 (4.2%). Other good combinations were 2x8 (29.0%) and 5x15 (27.0%).

Inbreeding depression in F2 ranged from 1.51% (3x12) to 55.0% (1x8). Increase over F1 was observed in 38 F2 populations. Maximum increase was observed in 5x11 (134.6%) followed by 1x11 (97.5%), 5x14 (89.0%) and 4x12 (86.8%).

(9) 1000-grain weight: Heterosis over better parent ranged from -21.4% (3x8) to 44.2% (3x14). 45 F1 combinations exhibited positive heterosis. Superior combinations were 3x14 (44.2%), 4x14 (44.1%), 7x15 (40.0%) and 5x14 (40.9%).

Heterosis over mid parent ranged from -11.6% (3x8) to 56.1% (10x15). 54 F1 combinations showed positive heterosis. The good combinations were 10x15 (56.1%), 7x15 (52.5%), 8x13 (51.2%) and 7x13 (55.0%).

Increase over the best variety was observed in 20 combinations, the range being from 1.2% (8x12) to 21.0% (1x10). Other superior combinations were 1x12 (16.9%), 2x10 (16.7%) and 2x11 (15.4%).

Inbreeding depression in F2 population ranged from -0.1% (2x12) to -30.8% (1x10). Increase was observed in six F2 populations, the range being from 0.3% (1x5) to 16.4% (4x3). Other superior F2 populations were 4x9 (10.2%), 1x8 (9.5%) and 5x9 (9.4%).
(10) Grain yield per spike: Heterosis over better parent ranged from -53.5% (5x11) to 75.5% (9x15). 21 F₁ combinations expressed positive heterosis. Superior combinations were 9x15 (75.5%), 7x15 (72.2%), 10x15 (49.1%) and 9x14 (45.2%).

Heterosis over mid parent ranged from -32.8% (5x11) to 152.4% (8x15). 39 F₁ combination exhibited positive heterosis. Superior combinations were 8x15 (152.4%), 7x15 (111.3%) and 9x15 (82.9%).

Increase over best variety was observed in six F₁ hybrids, the range being from 5.1% (1x8) to 27.5% (1x5). Other good combinations were 2x6 (14.8%) and 1x6 (8.6%).

Inbreeding depression in F₂ ranged from -1.1% (6x12) to -27.2% (8x15). Increase over F₁ was observed in 23 F₂ populations. Maximum increase was noticed in 5x11 (48.1%) followed by 11x15 (34.6%), 4x8 (31.4%) and 5x14 (25.0%).

(11) Grain yield per plant: Heterosis over better parent ranged from -30.1% (5x11) to 129.2% (5x15). 38 F₁ combinations expressed positive heterosis. Superior combinations were 5x15 (129.2%), 9x15 (89.3%), 6x15 (87.4%), 9x14 (71.7%) and 1x8 (71.5%).

Heterosis over mid parent ranged from -25.3% (4x11) to 187.1% (5x15). 48 F₁ combinations showed positive heterosis. The superior combinations were 5x15 (187.1%), 6x15 (143.8%), 9x15 (135.4%), 8x15 (99.1%) and 4x15 (96.5%).

Increase over best variety was observed in 12 F₁ combinations, the range being from 1.6% (3x7) to 71.5% (1x8). Other superior combinations were 5x15 (28.0%), 1x6 (26.1%), 2x8 (24.3%) and 2x6 (22.0%).
Inbreeding depression was observed in 39 F₂ populations, the range being from -2.8% (5x12) to -50.1% (1x3). 21 F₂ populations were found superior to their F₁'s. Among them 5x11 (102.5%), 11x15 (67.8%) and 4x12 (44.4%) were found to be most promising.

(12) Protein content: Heterosis over better parent ranged from -28.6% (2x8) to 22.7% (1x11). Positive heterosis was observed in 18 F₁ combinations. Superior combinations were 1x11 (22.7%), 1x5 (13.4%), 2x11 (12.4%) and 4x9 (10.5%).

Heterosis over mid parent ranged from -26.8% (2x8) to 33.5% (1x11). Positive heterosis was observed in 26 combinations. Superior hybrids were 1x11 (33.5%), 1x5 (18.2%), 2x11 (12.8%) and 6x12 (12.4%).

Inbreeding depression was observed in 23 F₂ populations, the range being from -0.1% (7x11) to -22.5% (1x11). In 37 F₂ populations increase, ranging from 0.4% (6x15) to 22.1% (2x8) was observed. Superior F₂ populations exceeding their F₁ hybrids were 2x8 (22.1%), 4x15 (16.1%), 2x6 (12.1%), 8x14 (11.9%) and 2x12 (11.5%).

6. Heritability:

Heritability, in narrow sense, was estimated from F₁ and F₂ populations separately for each of the characters. The estimates are presented in Table 12.

In F₁ cross combinations heritability was very high for kernel colour (82.57%), number grains per spike (71.13%), grain yield per spike (69.56%) and days to heading (61.28%).
It was high for peduncle length (50.68%), grain development period (49.63%), area of flag leaf (49.28%), 1000-grain weight (46.12%), number of grains per plant (45.24%), extrusion of peduncle (45.23%) and number of ears per plant (40.00%). These estimates were medium for awn length (37.50%), ear length (32.00%), plant height (26.46%) and grain yield (24.7%), whereas it was low for protein content (16.67%).

Heritability when measured from F2 population, was found to be very high for kernel colour (92.24%), number of grains per spike (78.56%), grain yield per spike (75.00%) and grain yield per plant (62.75%). It was high for number of grains per plant (49.98%), 1000-grain weight (48.37%), area of flag leaf (48.06%), ear length (47.91%), heading days (46.75%), number of ears per plant (46.21%), protein content (44.82%) and awn length (44.44%). It was medium for grain development period (37.08%), extrusion of peduncle (35.82%), plant height (33.54%) and peduncle length (30.89%).

It is evident that heritability in F2, as compared to F1, was considerably high for plant height, awn length, ear length, grain yield per plant and protein content, and low for peduncle length, extrusion of peduncle, heading days and grain development period.

In both the populations high heritability was observed for eight characters viz., days to heading, kernel colour, area of flag leaf, ears per plant, number of grains per spike, number of grains per plant, 1000 grain weight and grain yield per spike.
7. Genetic advance:

Estimation of genetic advance was also made from \( F_1 \) and \( F_2 \) populations for all the characters under investigation. These estimates are presented in Table 12.

Genetic gain in \( F_1 \) was highest for number of grains per plant (112.59) and high for number of grains per spike (22.58). It was low for yield per spike (0.69), awn length (0.57), ear length (0.46) and protein content (0.32).

In \( F_2 \) populations the genetic advance was highest for number of grains per plant (57.95) and high for grains per spike (17.41). It was low for awn length (0.67), ear length (0.69), grain yield per spike (0.62) and protein content (0.50).

As compared to \( F_1 \), there was an improvement in genetic gain in \( F_2 \) for plant height, awn length, ear length, ear length, area of flag leaf, grain yield per plant and protein content.

In both the populations, genetic gain was consistently high for number of grains per plant followed by number of grains per spike.

8. Genetic advance in percentage of mean:

The absolute values of genetic advance do not give the real picture of the comparative performance of different traits. Therefore genetic advance in percentage of mean was also calculated, for all the traits, in \( F_1 \) and \( F_2 \) populations (Table 12).

In \( F_1 \), the genetic gain was high for kernel colour
(83.33%), grains per spike (52.99%), grain yield per spike (34.32%), number of grains per plant (34.21%) and area of flag leaf (30.38%). It was moderate for protein content (27.74%), extrusion of peduncle (21.74%), number of ears per plant (14.19%), 1000-grain weight (13.50%) and grain yield per plant (12.49%). For other characters it was low.

In F₂ population the trend was similar to F₁. The genetic gain was high for kernel colour (88.36%), protein content (42.26%), number of grains per spike (36.03%), area of flag leaf (34.28%) and grain yield per spike (31.79%). It was moderate for grain yield per plant (20.19%), number of grains per plant (16.68%), extrusion (16.39%), and number of ears per plant (13.60%). For other characters it was low.

The percentage of genetic gain was appreciably improved in F₂, in comparison to F₁, for plant height, awn length, ear length, grain yield per plant and protein content and low for peduncle length, extrusion, number of grains per spike, number of grains per plant and 1000 grain weight.