CHAPTER IV

EXPERIMENTAL FINDINGS

The results obtained from analysis of sixty-eight rice cultivars are presented under the following subheadings,

4.1. Mean performance

4.2. Studies on genetic parameters

4.3. Differential evaluation of genetic parameters for three different seasons.

4.4. Screening for drought and pre-harvest sprouting tolerance

4.5. Character associations

4.6. Genetic divergence studies

4.1. Mean performance:

Selection is effective when there is significant amount of variations among the individuals in a population. Through this study an attempt was made to assess the mean performance, extent of variability and genetic divergence among 68 rice cultivars of different season’s viz. sali, ahu and bao for nineteen yield attributing, five nutritional and six other morphological quantitative and one qualitative characters. According to the mean performance a wide range of variation was found for most of the experimented characters. All the characters under consideration are elaborated individually here as under:

4.1.1. Yield and yield attributing characters:

The estimates of mean, range, etc. for all nineteen yields and yield attributing traits studied are explained here under,
4.1.1.1 Plant height:

Plant height varied from 78.80 cm to 217.8 cm (Table 4.1.1.1 and Fig. 4.1.1.1), while among the indigenous cultivars, plant height varied from 102.4 cm to 217.8 cm with a mean value of 132.70 cm. The highest plant height was observed in cultivar *Dalbao* which was significantly different from *Moubora, Beoilahi, Harmoni, Borguni, Betguti, Gorokhiasali, Sokuwa, Nekera, Malbhug, Torawali, Ronga-ahu, Gorundopakhi, Johabara, Sunmoni, Kola-ahu, Chutibora, Gumibora, Adoliabao, Nania, Guwahatiabora, Rongabora, Maiguni, Kolajoha, Basdhan, Mala, Ijong and Ronjit*. However semi-dwarf cultivars were *Ahumsali* (130.8 cm), *Beoilahi* (121.4 cm), *Gorokhiasali* (119.6 cm), *Gorundopakhi* (114.4 cm), *Gejepsali* (125.8 cm), *Harmoni* (121.2 cm), *Jaldubi* (127.8 cm), *Joha* (130.2 cm), *Katibora* (123.00 cm), *Malbhug* (117.2 cm), *Moubora* (121.8 cm), *Nekera* (117.8 cm), *Niokadam* (128.2 cm), *Sokuwa* (118 cm), *Torawali* (117 cm), *Betguti* (120 cm), *Borguni* (120.4 cm), *Kopouguni* (128.6 cm), *Ronga-ahu* (117 cm) and *Rongadoria* (130.8 cm). The check varieties showed minimum height ranging from 78.8 cm (*Ronjit*) to 99.6 cm (*Basdhan*).

4.1.1.2 Tillers per hill:

The data revealed that tillers per hill ranged from 7.6 to 29.6 (Table 4.1.1.2 and Fig. 4.1.1.2) with a mean value of 12.99. The highest tillers per hill were exhibited by cultivar *Kokuwabao* (28.8) followed by *Amanabao* (20.8). These values were somewhat close to the check varieties viz. *Ronjit* (29.6), *Ijong* (21.8), *Mala* (20.4) and *Basdhan* (19.4).
4.1.1.3 Days to 50% flowering:

Days to 50% flowering varied from 65.6 days (Borguni) to 226.2 days (Kokuwabao) (Table 4.1.1.3 and Fig. 4.1.1.3). Kokuwabao was significantly different from Beoilahi, Bogisali, Ahumsali, Niokadam, Titaphuliabora, Gorokhiasali, Sowagmoni, Bogijul, Laudubi, Kolapakhi, Nolsitiki, Nania, Pakhoribora, Tilbora, Bordhan, Chutibora, Khoiron, Rongajoha, Sorujahingia, Kolajoha, Torawali, Jaldubi, Gejepsali, Monlohi, Borjahingia, Nekera, Joha, Gumibora, Katibora, Gorundopakhi, Rongabora, Memlahi, Jahingia, Bora, Adoliabao, Malbhug, Solpuna, Johabora, Guwahatiabora, Sokuwa, Harmoni, Konjoha, Sunmoni, Moubora, Monuharsali, Vasmoti, Ronjit, Mala, Ijong, Basdhan, Maiguni, Kopouguni, Betguti, Ronga-ahu, Kola-ahu, Bejilahi, Rongadoria, and Borguni. All the experimented ahu cultivars were observed as early flowering variety. Days to 50% flowering among these cultivars were ranges from 65.6 days to 80 days. On the other hand late flowering was reported in all the bao cultivars (ranging from 226.4 days to 198.4 days). The wide range indicates ample variability among cultivars and a better scope for improvement in terms of this character. The range of days to 50% flowering in check varieties was 98.8 to 107.8 days.

4.1.1.4. Leaf-area:

The data revealed that leaf-area ranged from 36.9 cm$^2$ to 146.5 cm$^2$ (Table 4.1.1.4 and Fig. 4.1.1.4) with a mean value of 76.6 cm$^2$. The highest leaf-area was exhibited by cultivar Gorokhiasali. It was observed that all the ahu cultivars had comparatively lower leaf-area-index than sali and bao cultivars. The wide range indicates sufficient variability and scope for improvement for this character.
4.1.1.5. Flag-leaf length:

The flag-leaf length ranged from 27.04 cm to 54.28 cm (Table 4.1.1.5 and Fig. 4.1.1.5) with a mean value of 40.6 cm. The highest flag-leaf length was observed in cultivar Konjoha followed by Niokadam (52.16 cm) and Bogijul (51.44 cm), while the lowest value was recorded in Betguti (27.04 cm) followed by Bhubao (27.50 cm).

4.1.1.6. Flag-leaf breadth:

The flag-leaf breadth ranged from 1.12 cm to 2.54 cm (Table 4.1.1.6 and Fig. 4.1.1.6) with a mean value of 1.80 cm. The highest flag-leaf breadth was observed in cultivar Titaphuliabora followed by Kokuwabao (2.48 cm), while the lowest value was recorded in Konjoha (1.12 cm) followed by Adoliabao (1.26 cm).

4.1.1.7. Total chlorophyll content:

The data revealed that total chlorophyll content ranged from 1.51 mg/g to 5.23 mg/g with a mean value of 3.50 mg/g (Table 4.1.1.7 and Fig. 4.1.1.7). The highest total chlorophyll content was exhibited by the cultivar Titaphuliabora which was significantly different from Ronga-ahu, Rongadoria, Gorundopakhi, Rongabora, Tilbora, Happybao, Maiguni, Konjoha, Bejilahi, Niokadam, Malbhug, Betguti, Sokuwa, Katibora, Kokuwabao, Negheribao, Dalbao, Kolajoha, Jaldubi, Moubora, Bhubao, Basdhan, Jalingia, Kopouguni, Chutibora, Ijong, Laudubi, Sorujahingia, Rongajoha, Memlahi, Miabao, Sunmoni, Gumibora, Solpuna, Amanabao, Khoiron, Johabora and Monlohi. Titaphuliabora was followed by Bora (4.85 mg/g) and Sowagmoni (4.81 mg/g) while Monlohi (1.51 mg/g) showed lowest total chlorophyll content.
4.1.1.7.1. Chlorophyll a content:

The data revealed that chlorophyll a content varied from 0.74 mg/g to 3.19 mg/g with a mean value of 1.91 mg/g (Table 4.1.1.7 and Fig. 4.1.1.7). Maximum chlorophyll a content was observed in Titaphuliabora followed by Guwahatiabora (2.93 mg/g), while minimum value was showed by Monlohi (0.74 mg/g) and Khoiron (0.82 mg/g). Titaphuliabora was significantly different from Sorujahingia, Memlahi, Amanabao, Solpuna, Sunmoni, Bhubao, Khoiron and Monlohi. The check varieties had a range of 1.08 mg/g to 2.72 mg/g chlorophyll a content.

4.1.1.7.2 Chlorophyll b content:

The data revealed that chlorophyll b content varied from 0.08 mg/g to 2.56 mg/g with a mean value of 1.59 mg/g (Table 4.1.1.7 and Fig. 4.1.1.7). Maximum chlorophyll b content was observed in Tilbora and was significantly different from Moubora, Chutibora, Rongajoha, Gumibora and Johabora. Minimum value was showed by Johabora (0.08 mg/g) and Gumibora (0.52 mg/g) for this trait. The check varieties had a range of 0.80 mg/g to 1.57 mg/g chlorophyll b content.

4.1.1.8. Grain length:

The grain length varied from 5.62 mm to 11.24 mm (Table 4.1.1.8, Fig. 4.1.1.8 and Plate 4.1) with a mean value of 8.38 mm. The highest grain length was observed in cultivar Bejilahi (11.24 mm) followed by Niokadam (10.5 mm), whereas cultivar Konjoha had showed lowest grain length (5.62 mm) followed by Betguti (6.24 mm).
4.1.1.9. Grain breadth:

The experimental data on grain breadth revealed that this character ranged from 2.24 mm to 3.88 mm with a mean value of 3.16 mm (Table 4.1.1.9, Fig. 4.1.1.9 and Plate 4.1). The widest grain was from cultivar Katibora followed by Maguribao (3.86 mm), Bordhan (3.86), Gejepsali, Laudubi (3.86) and Titaphuliabora (3.86 mm). However, the lowest grain breadth was shown by Konjoha and Bogijul (2.24 mm).

4.1.1.10. Length to breadth (L/B) ratio of grain:

Grain length to breadth ratio ranged from 2 to 3.88 (Table 4.1.1.10, Fig. 4.1.1.10 and Plate 4.1). Highest length to breadth ratio was shown by cultivar Bejilahi (3.88) and the lowest L/B ratio by cultivars Betguti and Kopouguni (2.00). The mean value of L/b ratio was 2.69.

4.1.1.11. Harvest index:

The data revealed that harvest index ranged from 8.06% to 59.09% with a mean value of 35.73% (Table 4.1.1.11 and Fig. 4.1.1.11). Highest harvest index was shown by Ahumsali followed by Memlahi (58.30%), whereas the lowest value regarding harvest index was shown by Adoliabao. The range of harvest index in the four check varieties were 57.77% in Mala, 56.81% in Ronjit, 55.42% in Ijong and 32.49 in Basdhan which were lower than some indigenous cultivars such as Ahumsali, Memlahi etc.

4.1.1.12. Length of panicle:

The experimental data on panicle length revealed that this character ranged from 18.62 cm to 34.54 cm with a mean value of 27.27 cm (Table 4.1.1.12 and Fig.
4.1.1.12. Highest panicle length was shown by Bogisali followed by Negheribao (33.74 cm), Happybao (33.67 cm), Memlahi (33.60 cm) and Ahumsali (33.5 cm), whereas Khoiron had showed lowest value for panicle length.

4.1.1.13. Test (1000 seeds) weight:

The character test (1000) weight varied from 10.45 gm to 40.86 gm with a mean value of 23.77 gm (Table 4.1.1.13 and Fig. 4.1.1.13). The highest test weight was shown by Pakhoribora followed by Jaldubi (36.39 gm), whereas lowest test weight was shown by Konjoha (10.45 gm). The highest value of Pakhoribora was significantly different from Ronga-ahu, Adoliabao, Beoilahi, Gumibora, Joha, Amanabao, Kokuwabao, Torawali, Panidhan, Khoiron, Katibora, Nolsitiki, Nekera, Borguni, Guwahatiabora, Kola-ahu, Negheribao, Mala, Solpuna, Chutibora, Rongajoha, Nania, Bhubao, Sorujahingia, Betguti, Kopoguni, Bogijul, Maiguni, Rongadora, Basdhan, Ronjit, Ijong, Kolajoha, Vasmoti and Konjoha. The range of test weight within check varieties was 15.49 gm to 21.59 gm and was below the mean value.

4.1.1.14. Spikelets per panicle:

The data revealed that spikelet per panicle of the experimented indigenous cultivars varied from 99.60 to 447.80 with a mean value of 237.22 (Table 4.1.1.14 and Fig. 4.1.1.14). Cultivar Katibora had showed highest spikelets per panicle (significantly different from Panidhan, Tilbora, Guwahatiabora, Bejilahi, Beoilahi, Sunmoni, Sokuwa, Dalbao, Rongajoha, Kokuwabao, Laudubi, Sorujahingia, Sowagmoni, Katibora, Johabora, Joha, Monlohi, Bora, Kola-ahu, Harmoni, Solpuna, Ronga-ahu, Kolajoha, Kolapakhi, Nolsitiki, Ijong, Pakhoribora, Rongabora, Niokadam, Gorokhiasali, Bordhan, Borjahingia, Mala, Jahingia, Borguni, Betguti,
Vasmoti, Torawali, Chutibora, Kopouguni, Basdhan, Moubora, Gumibora, Adoliabao,
Gorundopakhi and Ronjit), followed by Niokadam (408.00) and Bogisali (407.60),
whereas the lowest spikelets per panicle was shown by Gejepsali (112.8). The check
variety Ronjit had showed lowest number of spikelets per panicle (99.60) among all
cultivars. The range of spikelets per panicle of the check varieties was 99.60 to 192.8.

4.1.1.15. Percentage of viable seeds:

A perusal of mean values for percentage of viable seeds depicted that it
ranged from 68.32% to 97.36% with a mean value of 87.70% (Table 4.1.1.15 and Fig.
4.1.1.15). Maximum percentage of viable seeds was observed in Moubora followed by
Niokadam (96.43%), while the cultivar Harmoni had lowest percentage of viable seeds
(68.32%). The range of the percentage of viable seeds within check varieties was
90.32% to 95.06%.

4.1.1.16. Spikelet density:

The data revealed that spikelet density of the experimented indigenous
cultivars varied from 4.49 to 18.01 no./cm with a mean value of 8.69 no./cm (Table
4.1.1.16 and Fig. 4.1.1.16). Cultivar Khoiron had showed highest spikelet density
followed by Gumibora (17.67 no./cm), whereas the lowest spikelet density was shown
by Adoliabao (4.49 no./cm). The highest value of spikelet density showed by laudubi
was significantly different from Laudubi, Ronga-ahu, Bordhan, Kolapakhi, Joha,
Solpuna, Bora, Harmoni, Pakhoribora, Dalbao, Kokuwabao, Jahingia, Mala,
Rongabora, Borguni, Niokadam, Gorokhiasali, Borjagingia, Betguti, Chutibora,
Basdhan, Gumibora, Moubora, Nolsitiki, Kopouguni, Torawali, Vasmoti,
Gorundopakhi, Ronjit and Adoliabao. The range of spikelet density of the check varieties was 4.58 to 7.99 no./cm.

4.1.1.17. Spikelets per plant:

Spikelet per plant of the experimented cultivars varied from 813.20 to 6766.80 with a mean value of 2661.60 (Table 4.1.1.17 and Fig. 4.1.1.17). The highest number of spikelets per plant was observed in the cultivar Bhubao which was significantly differed by Sorujahingia, Katibora, Bejilahi, Joha, Beoilahi, Sokuwa, Pakhoribora, Johabora, Vasmoti, Niokadam, Jahingia, Laudubi, Borjakingia, Ronga-ahu, Kolahu, Bordhan, Gorokhiasali, Solpuna, Harmoni, Monlohi, Torawali, Kopouguni, Borguni, Betguti, Gumibora, Gorundopakhi, Chutibora, Moubora and Adoliabao and was followed by Maguribao (5530.40), while the lowest spikelets per plant was observed in Nolsitiki. The check varieties had showed 2418.00 to 3848.80 range of spikelets per plant.

4.1.1.18. Panicles per plant:

The experimental data on panicle per plant revealed that this character ranged from 7.00 to 28.8 with a mean value of 11.3 (Table 4.1.1.18 and Fig. 4.1.1.18). Highest panicle per plant was shown by Bhubao which was significantly differed by Bordhan, Maiguni, Gorokhiasali, Gumibora, Johabora, Sokuwa, Beoilahi, Bejilahi, Jaldubi, Nekera, Ronga-ahu, Bogisali, Kola-ahu, Bogijul, Laudubi, Solpuna, Harmoni, Moubora, Borguni, Monlohi, Betguti, Adoliabao and Chutibora. Bhubao was followed by Bejilahi (16.8). Lowest value was observed in Gorokhiasali and Adoliabao. The check varieties had showed maximum panicle number. The range
within check varieties for panicles per plant was 17.6 to 28.8. Ronjit had showed highest panicles per plant among all experimented cultivars.

4.1.1.19. Grain yield:

The data revealed that grain yield of the experimented indigenous cultivars varied from 16.51 to 149.68gm/pl with a mean value of 55.39gm/pl (Table 4.1.1.19 and Fig. 4.1.1.19). Cultivar Amanabao had showed highest grain yield followed by Ahumsali (149.68gm/pl.) and Panikokuwa (129.40gm/pl) whereas the lowest grain yield was shown by Adoliabao (16.51gm/pl). The highest value for grain yield (shown by Amanabao) was significantly differed by Sokuwa, Ijong, Tilbora, Bhubao, Bejilahi, Laudubi, Bogijul, Rongadoria, Johabora, Joha, Konjoha, Rongajoha, Ronjit, Pakhoribora, Katibora, Bordhan, Beoilahi, Maiguni, Borjahingia, Rongabora, Harmoni, Nolsitiki, Kolajoha, Guwahatiabora, Sorujahingia, Gorokhiasali, Basdhan, Monlohi, Solpuna, Kolahu, Ranga ahu, Torawali, Moubora, Gorundopakhi, Vasmoti, Gumibora, Borguni, Kopouguni, Chutibora, Betguti and Adoliabao. The range of grain yield of the check varieties was 34.77gm/pl. to 69.91gm/pl.

4.1.2. Nutritional aspects:

The estimates of mean, range, etc. for all five nutritional traits studied are explained here under

4.1.2.1. Total carbohydrate content:

The range of total carbohydrate content (Table: 4.1.2.1 and Fig. 4.1.2.1) was varied from 67.39% to 88.46% with a mean value of 79.67%. The highest total carbohydrate content was observed in Vasmoti (88.46%) and was significantly different from Maguribao, Gumibora, Bordhan, Khoiron and Katibora. Vasmoti was
followed by Joha (88.23%) the lowest total carbohydrate content was observed in Katibora followed by Khoiron (67.74%). The check varieties had showed a range of 77.32 to 87.91% of total carbohydrate content.

4.1.2.2. Starch content:

The data revealed that starch content varied from 28.36 % to 82.21 % with a mean value of 58.45% (Table 4.1.2.2 and Fig. 4.1.2.2). Maximum starch content was observed in Dalbao and was followed by Kolajoha (80.51%) and Jaldubi (79.30%), while minimum value was showed by Sokuwa, Bordhan (34.90%) and Kolapakhi (34.91%). Highest value was significantly different from Bogisali, Kolapakhi, Bordhan and Sokuwa. The check varieties had a range of 36.35% to 72.93% of starch content.

4.1.2.3. Amylose content:

A perusal of mean values for amylose content depicted that it ranged from 8.28% to 33.86% with a mean value of 23.78% (Table 4.1.2.3 and Fig. 4.1.2.3). Maximum amylose content was observed in Rongadoria which was significantly different from Johabora, Titaphuliabora, Sokuwa, Tilbora, Guwahatiabora and Bora. Highest value of Rongadoria was followed by Sunmoni (33.64%), while the cultivar Bora had minimum content of amylose followed by Guwahatiabora (9.11%) and Tilbora (9.47%). The range of the amylose content in check varieties was 27.21% to 31.22%. It was observed that all the check varieties had a medium range of amylose content.
4.1.2.4. Amylopectin content:

The experimented data revealed that amylopectin content varied from 2.64% to 67.57% with a mean value of 34.35% (Table 4.1.2.4 and Fig. 4.1.2.4) and was significantly different from Borjahingia, Solpuna, Sokuwa, Gorokhiasali, Bogijul, Kolapakhi, Ahumsali, Bordhan Ranjit and Bogisali. Maximum value was observed in cultivar *Tilbora* and minimum in cultivar *Bogisali*.

4.1.2.5. Protein content:

The experimented data revealed that protein content varied from 2.12% to 13.19% with a mean value of 7.56% (Table 4.1.2.5 and Fig. 4.1.2.5). The maximum value was observed in cultivar *Moubora* and was significantly different from Jahingia, Nolsitiki, Nania, Gorundopakhi, Memlahi, Ahumsali, Miabao, Happybao, Panidhan, Amanabao, Gejepsali, Pakhoribora, Kolaahu, Negheribao, Chutibora, Maguribao, Borguni, Monuharsali, Dalbao and Moubora. Minimum protein content was observed in *Bhubao* followed by Solpuna (2.45%). The check varieties had showed a range of 3.09% to 7.28% of protein content.

4.1.3. Additional characters related to yield and abiotic stresses:

The estimates of mean, range, etc. for all nine additional traits studied are explained here under

4.1.3.1. Germination percentage:

The experimented data revealed that germination percentage varied from 61% to 100% (Table 4.1.3.1 and Fig. 4.1.3.1). 12 cultivars had showed 100% germination with a mean value of 89.96%. They were Adoliabao, Ahumsali, Bogisali, Bora, Harmoni, Joha, Konjoha, Nekera, Pakhriborah, Solpuna, Sowagmoni and
Sunmoni. Minimum germination percentage was shown by cultivar Maiguni (61%) followed by Happybao (69%). Maximum value for percentage of germination was significantly differed by Maiguni and Happybao. All the check varieties had showed 100% germination.

4.1.3.2. Pollen viability:

The experimented data revealed that pollen viability varied from 63.40% to 91.6% with a mean value of 76.84% (Table 4.1.3.2 and Fig. 4.1.3.2). The maximum value was observed in cultivar Sorujahingia followed by Tilbora (88.00%), whereas minimum percentage of pollen viability was observed in Niokadam followed by Vasmoti (63.80%). Sorujahingia was significantly differed from Rongadoria, Gejepsali, Jahingia, Negheribao, Kolaahu, Rongabora, Vasmoti and Niokadam. The check varieties had showed a range of 69.20 to 91.60 percent of pollen viability. Among all cultivars the check variety Ronjit (91.60%) had showed highest percentage of pollen viability.

4.1.3.3. Length of the flag-leaf sheath:

Flag-leaf sheath length was varied from to 24.00 cm to 50.00 cm with a mean value of 36.20 cm (Table 4.1.3.3 and Fig. 4.1.3.3). Highest flag-leaf sheath length was observed in cultivar Amanabao and Titaphuliabora (50.00 cm) and was significantly differed by Panikokuwa, Negheribao, Gumibora, Vasmoti, Kolajoha, Maiguni, Gejepsali, Gorundopakhi, Jahingia, Bhubao, Jaldubi, Johabora and Dalbao. While lowest value was observed in cultivar Dalbao (24.00 cm). Johabora had followed Dalbao with a value of 24.80 cm. All the check varieties had showed a medium range of flag-leaf sheath length (31.40 cm to 35.00 cm).
4.1.3.4. Length of the root:

The experimented data on length of the root revealed that this character ranged from 17.74 cm to 33.08 cm with a mean value of 23.78 cm (Table 4.1.3.4 and Fig. 4.1.3.4). The highest root length was observed in a ahu cultivar Rongadoria followed by Bejilahi (32.68 cm) and Gorundopakhi (31.78 cm). Rongadoria was significantly differed from Amanabao, Negheribao, Basdhan, Pakhoribora, Nekera, Kolapakhi, Kokuwabao, Sokuwa, Jaldubi, Bhubao, Monuharsali, Konjoha, Kolaahu, Panikokuwa, Sunmoni, Solpuna, Bogijul and Sorajahingia. Minimum root length among the experimented cultivars was observed in Solpuna and Bogijul (18.80 cm) followed by Sunmoni (18.86 cm). The range of root length in the check varieties was 20.60 cm to 31.20 cm.

4.1.3.5. Number of xylem vessels:

The xylem number of the experimented cultivars ranged from 3.04 to 8.40 with a mean value of 5.46 (Table 4.1.3.5, Fig. 4.1.3.5 and Plates 4.2, 4.3, 4.4, 4.5). Maximum xylem number was shown by a bao cultivar Miabao (8.00) followed by an ahu cultivar Kopouguni (7.60), whereas minimum xylem number was observed in Nolsitiki (3.40) followed by Katibora and Bejilahi (3.60). Miabao was significantly different from Laudubi, Jahingia, Gorokhiasali, Tilbora, Memlahi, Monuharsali, Johabora, Joha, Bora, Bogijul, Ranjit, Sunmoni, Sowagmoni, Rongajoha, Pakhoribora, Nekera, Nania, Kolajoha, Sokuwa, Guwahatiabora, Maiguni, Monlohi, Bejilahi, Katibora and Nolsitiki. The check varieties had showed a range of 4.6 to 8.4 for xylem number in their roots.
4.1.3.6. Number of stomata on upper surface:

A perusal of mean values for number of stomata on upper surface depicted that it ranged from 24.60 to 57.60 with a mean value of 38.71 (Table 4.1.3.6 and Fig. 4.1.3.6). Maximum number of stomata on upper surface was observed in Moubora followed by Titaphuliabora (53.00), while the cultivar Betguti had lowest number of stomata on upper surface followed by Amanabao (25.20). Moubora with maximum number of stomata on upper surface was significantly different from Bora, Laudubi, Bogisali, Ronga-ahu, Chutibora, Gumbora, Solpuna, Gorundopakhi, Monlohi, Johabora, Mala, Sokuwa, Gorokhiasali, Gejepsali, Nania, Borjahingia, Vasmoti, Basdhan, Guwahatiabora, Maiguni, Jahingia, Ijong, Ronjit, Nolsitiki, Miabao, Tilbora, Adoliabao, Bhubao, Amanabao and Betguti. The range of the number of stomata on upper surface within check varieties was 31.00 to 35.60.

4.1.3.7. Number of stomata on lower surface:

The data reveal that number of stomata on lower surface varied from 17.60 to 77.80 with a mean value of 49.75 (Table 4.1.3.7 and Fig. 4.1.3.7). Maximum number of stomata on lower surface was observed in Amanabao and was significantly different from Kokuwabaoba, Dalbao, Rongajoha, Tilbora, Vasmoti, Panikokuwa, Ronjit, Nania, Johabora, Gorokhiasali, Guwahatiabora, Solpuna, Panidhan, Torawali, Sokuwa, Bogisali, Kopouguni, Basdhan, Monuharsali, Laudubi, Rongadoria, Moubora, Negheribao, Jaldubi, Nolsitiki, Beoilahi, Memlahi, Jahingia, Bhubao, Adoliabao, Harmoni, Monlohi and Betguti. Minimum value was observed in Betguti (17.60) followed by Monlohi (29.40). The check varieties showed a range of 48.40 to 54.00 for number of stomata on lower surface of leaves.
4.1.3.7. Grain type:

According to Systematic classification of rice grain (RAMAIAH COMMITTEE, 1969), (Table 3.4) among the 46 sali cultivars 34 cultivars were long bold type (LB), 11 cultivars were long slender type (LS), and one cultivar viz. Konjoha was medium slender type (MS) (Table: 4.1.4.1). Among the 10 bao cultivars 9 cultivars were long bold (LB) type and only one cultivar viz. Panikokuwa was long slender type (LS) (Table: 4.1.4.2). Among ahu cultivars 7 were long bold type (LB) and only one cultivar (Bejilahi) was long slender type (LS) (Table: 4.1.4.3) among four check varieties 3 (viz. Basdhan, Ijong and Ronjit) were long bold (LB) type and one (viz. Mala) was long slender type (LS) (Table. 4.1.4.4).

4.2. Studies on genetic parameters:

Variability of the experimented cultivars was measured by estimation of the genotypic and phenotypic variance, genotypic and phenotypic coefficient of variation, heritability (broad sense) and genetic advance. Environment plays a significant role in the expression of genotypic and phenotypic characters, estimation of which can be possible from phenotypic observations with biometry. Thus variability can be observed through biometric parameters such as genotypic coefficient of variation, heritability, genetic advance etc. These variability measures can be effectively used and would be of great help to the breeders in deriving selection programme for gene.

The estimates of variance, coefficient of variation, heritability and genetic advance for all the characters studied are explained here under.
4.2.1. Estimation of genotypic ($\sigma^2_g$) and phenotypic ($\sigma^2_p$) variance:

4.2.1.1. Genotypic ($\sigma^2_g$) and phenotypic ($\sigma^2_p$) variance of 19 important yield and yield attributing traits.

Results on genotypic and phenotypic variances of important yield and yield attributing characters revealed a wide range of variability for maximum characters (Table: 4.2.1 and Fig. 4.2.1). The maximum variability (genotypic and phenotypic) was observed in spikelet per plant (1466100.40 and 1537697.90 respectively) followed by grain yield (279532.36 and 297103.78), spikelet per panicle (6435.55 and 6571.73), days to 50% flowering (1561.89 and 1571.9036), plant height (712.23 and 743.98), leaf area index (341.91 and 398.49), harvest index (119.36 and 138.34), flag-leaf length (35.19 and 47.19) and percentage of viable seeds (33.62 and 47.47). Moderate genotypic and phenotypic variances were observed in traits viz. 1000 seeds weight (24.39 and 25.37 respectively), tillers per plant (17.23 and 19.31), panicles per plant (16.71 and 18.05), and length of panicle (13.10 and 15.05). Whereas extremely low variances were shown by the traits flag-leaf breadth (0.11 and 0.12), grain breadth (0.14 and .19), L/B ratio (0.18 and 0.23), grain length (0.80 and 0.98) total chlorophyll content (0.900 and 0.905) and spikelet density (7.51 and 7.86).

It had been observed that in all the experimented characters, the phenotypic variance was higher than genotypic variance.

4.2.1.2. Genotypic ($\sigma^2_g$) and phenotypic ($\sigma^2_p$) variance of nutritional traits:

The maximum variability (genotypic and phenotypic) was observed (Table: 4.2.2 and Fig. 4.2.2) in character amylopectin content (252.94 and 253.3 respectively), which was followed by total starch content (219.14 and 219.47), protein
content (38.69 and 38.86), amylose content (35.26 and 35.61) and total carbohydrate content (31.05 and 31.60). It had been observed that in all the experimented characters, the phenotypic variance was higher than genotypic variance.

4.2.1.3. Genotypic (\(\delta^2_g\)) and phenotypic (\(\delta^2_p\)) variance of additional traits related to yield and abiotic stresses:

The maximum variability (genotypic and phenotypic) was observed (Table: 4.2.3, and Fig. 4.2.3) in the trait germination percentage (77.17 and 90.05 respectively) and was followed by number of stomata on lower surface (73.92 and 73.92), pollen viability (59.52 and 67.34), number of stomata on upper surface (37.48 and 41.84) and length of flag-leaf sheath (34.54 and 38.66). Moderate to genotypic and phenotypic variability were observed in traits viz. length of root (13.06 and 16.93), number of xylem vessels (1.16 and 1.53).

It had been observed that in all the experimented characters except number of stomata on lower surface, the phenotypic variance was higher than genotypic variance. While, the character, number of stomata on lower surface had showed equal amount of genotypic and phenotypic variance (73.92).

4.2.2. Genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV):

4.2.2.1. GCV and PCV of important yield and yield attributing traits:

The estimation of genotypic coefficient of variation (GCV) and phenotypic coefficient of variation (PCV) for experimented yield and yield attributing characters are presented in Table: 4.2.1 and Fig 4.2.1.
Genotypic coefficient of variation (GCV) of the yield and yield attributing traits ranged from 6.61% to 77.66%. High GCV was observed in grain yield (77.66%) followed by spikelet per plant (45.49%), panicle per plant (36.21%), spikelet per panicle (33.82%), tillers per plant (31.94%), spikelet density (31.53%), harvest index (30.58%), days to 50% flowering (29.46%), total chlorophyll content (27.14%), leaf area index (24.14%), 1000 seeds weight (20.78%), and height (20.11%). Moderate GCV were observed in traits viz. flag-leaf breadth (18.19%), grain length breadth ratio (15.60%), flag-leaf length (14.61%), panicle length (13.27%), grain breadth (11.85%) and grain length (10.69%). While low GCV was found in percentage of viable seeds (6.61%).

Phenotypic coefficient of variation (PCV) ranged from 7.88% to 80.06% in important 19 yield and yield attributing traits. High PCV was observed in grain yield (80.06%) followed by spikelet per plant (46.59%), panicle per plant (37.63%), spikelet per panicle (34.17%), tillers per plant (33.81%), harvest index (32.92%), spikelet density (32.25%), days to 50% flowering (29.55%), total chlorophyll content (27.22%), leaf area index (26.06%), 1000 seeds weight (21.19%) and height (20.55%). Moderate PCV were observed in traits viz. flag-leaf breadth (18.80%), grain length breadth ratio (17.98%), flag-leaf length (16.92%), panicle length (14.23%), grain breadth (13.86%) and grain length (11.80%). While low PCV was found in percentage of viable seeds (7.88%).

From the estimates of GCV and PCV it was revealed that PCV were higher than their corresponding GCV however a good correspondence was observed between GCV and PCV for all experimented characters.
4.2.2.2. GCV and PCV of nutritional traits:

Genotypic coefficient of variation (GCV) ranged from 45.85% to 6.99% in nutritional traits (Table: 4.2.2 and Fig. 4.2.2). High GCV were observed in traits all traits except total carbohydrate content. GCV for different nutritional traits were viz. for amylopectin content, 45.85%; for protein content, 39.02%; for total starch content, 25.32%; for amylose content, 24.98% and for total carbohydrate content, 6.99%.

Phenotypic coefficient of variation (PCV) for nutritional traits ranged from 45.88% to 7.05%. High PCV were observed in amylopectin content (45.88%), protein content (39.42%), total starch content (25.33%) and amylose content (25.06%), whereas low PCV was observed in total carbohydrate content (7.05%). It is noteworthy that all traits except total carbohydrate content had showed high PCV also.

From the estimates of GCV and PCV of nutritional traits, it was revealed that PCV were higher than their corresponding GCV however a good correspondence was observed between GCV and PCV.

4.2.2.3. GCV and PCV of traits related to yield and abiotic stresses:

From the experimented data it was revealed that genotypic coefficient of variation for traits related to yield and abiotic stresses ranged from 9.76% to 19.74% (Table: 4.2.3 and Fig. 4.2.3). Moderate GCV were observed in traits viz., number of xylem vessels (19.74%), number of stomata on lower surface of leaf (17.02%), length of flag leaf sheath (16.32%), number of stomata on upper surface (15.80%), length of root (15.20%) and pollen viability (10.03%), whereas low GCV was observed in the trait germination percentage (9.76%).
Phenotypic coefficient of variation for traits related to yield and abiotic stresses ranged from 10.55% to 22.67%. Moderate PCV were observed in traits viz., number of xylem vessels (22.67%), number of stomata on lower surface of leaf (17.28%), length of root (17.28%), length of flag leaf sheath (17.17%), number of stomata on upper surface (16.71%), and pollen viability (10.68%) and germination percentage (10.55%).

4.2.3. Heritability (broad sense):

Coefficients of variation alone are not helpful in determining the heritable portion of variation. For this, estimation of heritability of these traits is necessary, which is reported in following results.

4.2.3.1. Heritability (broad sense) of important yield and yield attributing traits:

By a perusal of data (Table: 4.2.1 and Fig. 4.2.1), it is evident that the heritability (broad sense) estimated for yield and yield attributing traits under study, ranged from 70% to 99%. It was interesting to note that all traits showed high heritability. Highest heritability were observed for traits days to 50% flowering (99.00%) and total chlorophyll content (99.00%) and were followed by spikelet per panicle (98%), height (96.00%), 1000 seeds weight (96.00%), spikelet density (96.00%), spikelet per plant (95.00%), grain yield (94.00%), flag-leaf breadth (94.00%), panicle per plant (93.00%), tillers per plant (89.00 %), length of panicle (87.00%), harvest index (86.00%), leaf area index (86.00%), grain length (82.00%), L/B ratio (75.00%), flag-leaf length (75.00%), grain breadth (73.00%) and percentage of viable seeds (70.00%).
4.2.3.2. Heritability (broad sense) of nutritional traits:

Heritability estimates (Table: 4.2.2 and Fig. 4.2.2) of nutritional traits revealed that all traits were highly heritable. The range of heritability among nutritional traits was 99.86% to 98.08%. Highest heritability (broad sense) was observed in trait amylopectin content (99.86%) and was followed by total starch content (99.85%), amylose content (99.01%), total carbohydrate content (98.24%) and protein content (98.08%).

4.2.3.3. Heritability (broad sense) of additional traits related to yield and abiotic stresses:

Heritability (broad sense) estimated (Table: 4.2.3 and Fig. 4.2.3) for additional traits related to yield and abiotic stresses under study, ranged from 75.85% to 99.99%. It was noteworthy that all traits had showed high heritability. Highest heritability was observed for trait number of stomata on lower surface of leaf (99.99%) and was followed by number of stomata on upper surface (89.59%), length of flag-leaf sheath (89.36%), percentage of pollen viability (88.38%), germination percentage (85.69%), length of root (77.15%) and number of xylem vessels (75.85%).

4.2.4. Genetic advance:

4.2.4.1. Genetic advance of important yield and yield attributing traits:

It had been observed (Table: 4.2.1 and Fig. 4.2.1) that the genetic advance for quantitative yield and yield attributing traits under study was ranged from 0.66 to 2435.54. Highest genetic advance was observed for the trait spikelet per plant (2435.54) followed by grain yield (1056.44), spikelet per panicle (163.54), days to 50% flowering (81.15), height (53.79), leaf area index (35.28), harvest index (20.91),
flag-leaf length (10.55), percentage of viable seeds (10.03), 1000 seeds weight (9.97), panicle per plant (8.10), tillers per plant (8.08), length of panicle (6.95), spikelet density (5.52), total chlorophyll content (1.95), grain length (1.67), L/B ratio (0.75), flag leaf breadth (0.66) and grain breadth (0.66).

4.2.4.2. Genetic advance of nutritional traits:

Genetic advance of experimented nutritional traits ranged (Table: 4.2.2 and Fig. 4.2.2) from 6.02 to 3272.87. Highest genetic advance among nutritional traits was exhibited by amylopectin content (3272.87). This was followed by total starch content (30.2), amylose content (12.15), total carbohydrate content (11.34) and protein content (6.02).

4.2.4.3. Genetic advance of additional traits related to yield and abiotic stresses:

By a perusal of data (Table: 4.2.3 and Fig. 4.2.3), it is evident that genetic advance of the additional traits related to yield and abiotic stresses under study, ranged from 17.53 to 1.91. Highest genetic advance was observed in the trait number of stomata on lower surface of leaf (17.53). This was followed by germination percentage (16.75), pollen viability (14.88), number of stomata on upper surface (11.86), length of flag-leaf sheath (11.40), length of root (6.52) and number of xylem vessels (1.91).

4.2.5. Genetic advance as percentage of mean (at 5% intensity):

4.2.5.1. Genetic advance as percentage of mean of important yield and yield attributing traits:

A perusal of genetic advance as percentage of mean for quantitative yield and yield attributing characters under study was ranged (Table: 4.2.1 and Fig. 4.2.1) from 11.43% to 155.17%. The highest genetic advance as percentage of mean was shown
by grain yield followed by spikelet per plant (91.51). High genetic advance as percentage of mean were shown by grain yield (155.17), spikelet per plant (91.51), panicle per plant (71.78), spikelet per panicle (68.94), spikelet density (63.51), tillers per plant (62.15), days to 50% flowering (60.49), harvest index (58.51), total chlorophyll content (55.75), leaf area index (46.07), 1000 seeds weight (41.96), height (40.53), flag-leaf breadth (36.27), L/B ratio (27.88), flag-leaf length (25.99), length of panicle (25.50) and grain breadth (20.88), while grain length (19.93) and percentage of viable seeds (11.43) had exhibited moderate genetic advance as percentage of mean.

4.2.5.2. Genetic advance as percentage of mean (GAM) of nutritional traits:

Genetic advance as percentage of mean estimate revealed (Table: 4.2.2 and Fig. 4.2.2) that all traits except total carbohydrate content had showed high genetic advance as percentage of mean. The range of GAM for nutritional traits was 14.24 to 94.37. Highest GAM was shown by amylopectin content (94.37) and was followed by protein content (79.58), total starch content (51.67), amylose content (51.11) and total carbohydrate content (14.24). Total carbohydrate content showed moderate GAM.

4.2.5.3. Genetic advance as percentage of mean of additional traits related to yield and abiotic stresses:

Study of the genetic advance as percentage of mean for additional traits revealed (Table: 4.2.3 and Fig. 4.2.3) that all the traits except percentage of pollen viability and germination percentage had showed high GAM. The range was 18.62 to 35.25 High GAM were shown by number of stomata on lower surface (35.25), number of xylem vessels (34.98), length of flag-leaf sheath (31.49), number of stomata on
upper surface (30.64) and length of root (27.41), whereas moderate GAM were exhibited by percentage of pollen viability (19.37) germination percentage (18.62).

4.3. Differential evaluation of genetic parameters for three different seasons.

Along with the estimation of genetic parameters considering all 68 cultivars together, the three seasonal groups of the cultivars were also estimated for the genetic parameters separately, to evaluate the variations among different seasonal groups.

4.3.1. Genotypic and phenotypic coefficient of variation:

4.3.1.1. GCV and PCV in sali cultivars:

From the Tables 4.3.1, 4.3.2, 4.3.3 and Figures 4.3.1, 4.3.2, it is observed that high GCV and PCV among sali cultivars were observed for the characters grain yield, amylopectin content, spikelet per plant, spikelet per panicle, panicle per plant, protein content, spikelet density, number of stomata on upper surface, harvest index, total chlorophyll content, amylose content, total starch content, leaf area index and 1000 seeds weight. Moderate GCV and PCV were observed in number of xylem vessels, flag-leaf breadth, length of flag-leaf sheath, number of stomata on lower surface, length of panicle, length of root, L/B ratio, flag-leaf length, grain breadth and percentage of pollen viability, whereas low GCV and PCV were observed in days to 50% flowering, grain length, germination percentage, total carbohydrate content, percentage of viable seeds, tillers per plant and height.

From the estimates of GCV and PCV in sali cultivars, it was revealed that PCV were higher than their corresponding GCV in these cultivars also. However a
good correspondence was observed between GCV and PCV for all experimented characters

4.3.1.2. GCV and PCV in *bao* cultivars:

From the Tables 4.3.1, 4.3.2, 4.3.3 and Figures 4.3.1, 4.3.2, it is observed that among *bao* cultivars highest GCV and PCV were for the character grain yield. High GCV and PCV were observed for the traits grain yield, amylopectin content, protein content, spikelet per plant, panicles per plant, tillers per plant, total chlorophyll content, spikelet density, total starch content, harvest index, spikelet per panicle, length of flag-leaf sheath, number of stomata (LS) and number of stomata (US). Moderate GCV and PCV were observed in traits viz., leaf area index, flag-leaf length, 1000 seeds weight, L/B ratio, amylose content, number of xylem vessels, height, flag leaf breadth and grain breadth, whereas low GCV and PCV were observed in traits viz., length of panicle, germination percentage, length of root, percentage of pollen viability, total carbohydrate content, grain length, percentage of viable seeds and days to 50% flowering.

From the estimates of GCV and PCV in *bao* cultivars, it was revealed that PCV were higher than their corresponding GCV in these cultivars also.

4.3.1.3. GCV and PCV in *ahu* cultivars:

From the Tables 4.3.1, 4.3.2, 4.3.3 and Figures 4.3.1, 4.3.2, it is observed that among *ahu* cultivars highest GCV and PCV were also for the character grain yield (120.04 and 121.06 respectively). High GCV and PCV were observed for traits viz., grain yield, spikelet per plant, protein content, amylopectin content, panicle per plant, number of stomata (LS), spikelet per panicle, L/B ratio, spikelet density, number of
xylem vessels, harvest index, total starch content, grain length, flag leaf length and number of stomata. Moderate GCV and PCV were observed in traits viz. amylose content, length of root, total chlorophyll content, length of flag-leaf sheath, 1000 seeds weight, germination percentage, leaf area index, tillers per plant and flag-leaf breadth, whereas low GCV and PCV were observed for traits viz. percentage of pollen viability, grain breadth, height, percentage of viable seeds, total carbohydrate content, days to 50% flowering and length of panicle.

From the estimates of GCV and PCV in *ahu* cultivars, it was revealed that PCV were higher than their corresponding GCV in these cultivars also.

4.3.2. Heritability:

4.3.2.1. Heritability in *sali* cultivars:

Maximum heritability in the *sali* cultivars was observed (Table: 4.3.1., 4.3.2, 4.3.3 and Fig. 4.3.3) in total starch content and amylopectin content (99.87%), followed by amylose content (99.12%), total chlorophyll content (99.00%). It is noteworthy that all experimented traits showed high heritability in *sali* cultivars.

4.3.2.2. Heritability in *bao* cultivars:

Maximum heritability (Table: 4.3.1., 4.3.2, 4.3.3 and Fig. 4.3.3) in the *bao* cultivars was observed in total carbohydrate content (100%), followed by amylopectin content (99.86%), total starch content (99.79%) and total carbohydrate content (99.50%). All experimented traits except length of root exhibited high heritability. Length of root showed moderate heritability among *sali* cultivars.
4.3.2.3. Heritability in *ahu* cultivars:

Maximum heritability in the *ahu* cultivars was also observed (Table: 4.3.1., 4.3.2., 4.3.3 and Fig. 4.3.3.) in total chlorophyll content (100%), followed by amylopectin content (99.87), total starch content (99.81%), total carbohydrate content (99.49%) and amylose content (99.21%). All experimented traits except tillers per plant exhibited high heritability. Tillers per plant showed moderate heritability among *ahu* cultivars.

4.3.3. Genetic advance as percentage of mean (5% intensity):

4.3.3.1. Genetic advance as percentage of mean (5% intensity) for *sali* seasonal cultivars:

A perusal of genetic advance as percentage of mean (GAM) for all the quantitative characters under study revealed (Table: 4.3.1., 4.3.2, 4.3.3 and Fig. 4.3.4) that highest genetic advance as percentage of mean was shown by grain yield (123.72) followed by amylopectin content (122.79). all characters except pollen viability, days to 50% flowering, grain length, germination percentage, total carbohydrate content, percentage of viable seeds and length of root had showed high GAM. Pollen viability, days to 50% flowering, grain length, germination percentage, total carbohydrate content and percentage of viable seeds showed moderate GAM, while length of root showed low GAM.

4.3.3.2. Genetic advance as percentage of mean (5% intensity) for *bao* seasonal cultivars:

A perusal of genetic advance as percentage of mean (GAM) for all the quantitative characters under study revealed (Table: 4.3.1., 4.3.2, 4.3.3 and Fig. 4.3.4)
that highest genetic advance as percentage of mean was shown by grain yield (127.48) followed by amylopectin content (82.49). All traits showed high GAM except flag-leaf breadth, length of panicle, grain breadth, total carbohydrate content, pollen viability, length of root, percentage of viable seeds, grain length and days to 50% flowering. Flag-leaf breadth, length of panicle, grain breadth, total carbohydrate content, pollen viability, length of root had showed moderate GAM while, percentage of viable seeds, grain length and days to 50% flowering had showed low GAM.

4.3.3.3. Genetic advance as percentage of mean (5% intensity) for ahu seasonal cultivars:

Genetic advance as percentage of mean (GAM) for all the quantitative characters under study revealed (Table: 4.3.1., 4.3.2, 4.3.3 and Fig. 4.3.4) that highest genetic advance as percentage of mean was shown by grain yield (245.22) followed by spikelet per plant (112.62). Except pollen viability, tillers per plant, grain breadth, height, total carbohydrate content, percentage of viable seeds, days to 50% flowering and length of panicle, all other traits had showed high GAM. Moderate GAM were shown by the traits viz., pollen viability, tillers per plant, grain breadth, height, total carbohydrate content, percentage of viable seeds, days to 50% flowering and length of panicle.

4.4. Screening of indigenous cultivars for drought tolerance and pre-harvest sprouting tolerance:

4.4.1. Screening for drought tolerance:

Characters contributing to drought tolerance viz. root length, number of xylem vessels, number of stomata (both upper and lower surface), flag-leaf length and
number of tillers per plant were considered together and scored as the character with the higher magnitude in the desired direction were given the first rank against each cultivar. Hence the cultivar with least overall score across six characters secured the first rank and the cultivar with the highest score secured the last rank (Table: 4.4.1). Cultivar *Betguti* with overall score 17 across the six characters gets the first rank followed by cultivar *Adoliabao* (total score 31), *Monlohi* (72), *Laudubi* (82), *Nolsitiki* (83) and *Gorokhiasali* (88).

4.4.2 Screening for pre-harvest sprouting tolerance:

Pre-harvest sprouting was absent in most of the cultivars. Only eight cultivars viz. *Bejilahi, Betguti, Borguni, Kola-ahu, Maiguni, Ronga-ahu, Kopouguni* and *Rongadoria* had showed pre-harvest sprouting. It is noteworthy that all the cultivars showing pre-harvest sprouting were *ahu* seasonal cultivars. Maximum pre-harvest sprouting was showed by cultivar *Kola-ahu* (68.00%) followed by *Borguni* (53.60%), *Rongadoria* (21.80%), *Maiguni* (18.20%), *Ronga-ahu* (14.40%), *Betguti* (9.80%), *Bejilahi* (9.00%) and *Kopouguni* (1.60%) (Table: 4.4.2 and Fig. 4.4.1).

4.5. Character association:

The estimation of correlation coefficients revealed (Table: 4.5) that genotypic and phenotypic correlation coefficients were with the same (whether positive or negative) sign in all the character pairs. Most of the genotypic correlation coefficients were of higher or equal in magnitude than the corresponding phenotypic correlation coefficients except panicle per plant and spikelet per plant and harvest index and grain yield. Panicle per plant and spikelet per plant and harvest index and grain yield had
showed higher magnitude of phenotypic correlation coefficients than genotypic correlation coefficients.

Highest correlation coefficient with grain yield was showed by the trait spikelet per plant. This was followed by panicle per plant and spikelet per panicle. In the present study grain yield per plant showed significant positive genotypic and phenotypic correlation coefficient with spikelet per plant (0.9 and 0.9 respectively) panicle per plant (0.75 and 0.75 respectively), spikelet per panicle (0.42 and 0.41 respectively), tillers per plant (0.39 and 0.38 respectively), spikelet density (0.35 and 0.33 respectively), flag leaf breadth (0.35 and 0.32 respectively), days to 50% flowering (0.32 and 0.31 respectively), length of the panicle (0.28 and 0.26 respectively) and height (0.28 and 0.27 respectively. Insignificant negative correlation of grain yield was observed with flag leaf length (-0.1) and grain breadth (-0.05) in present study. Highest significant negative correlation in both genotypic and phenotypic plane was observed between grain breadth and L/B ratio of grain (-0.72 and -0.74 respectively).

Harvest index showed significant positive correlation in both genotypic and phenotypic plane with tillers per plant (0.37 and 0.35 respectively), panicle per plant (0.36 and 0.35 respectively) flag leaf breadth (0.35 and 0.32 respectively) and flag leaf length (0.29 and 0.24 respectively).

4.6. Genetic divergence analysis:

All cultivars taken for genetic divergence analysis differed significantly with regards to the characters studied (Table: 4.6.1) and displayed remarkable divergence subjected to Wilk’s criterion, taking nineteen yield attributing characters together. The
value of ‘V’ statistics was showing significant difference among the 68 cultivars. Thus it would be worthwhile to classify the investigated gene pools into different groups on the basis of traits studied. It is an established fact that genetic diversity among the cultivars of a crop arises either due to genetic barrier to crossability or due to geographical separation. Generalised distance analysis is a method with the help of which we can classify a gene pool into different clusters on the basis of genetic relatedness within it. Plant breeders assumed that cultivars within the group are genetically related whereas diverse cultivars are classified into different clusters. This technique measures the force of differentiation at two levels, namely inter-cluster and intra-cluster. In the present study genetic divergence was evaluated by Mahalanobis D² statistics and Tocher’s method.

4.6.1. Group constellation:

Eleven clusters were formed by grouping all the 68 cultivars in such a way that cultivars within each cluster had smaller D² value (Table: 4.6.2) than those of other clusters. Cluster pattern revealed that, cluster I was largest consisting of 25 cultivars, followed by cluster II (13 cultivars), III and IV (9 cultivars each), V (4 cultivars) and VI (3 cultivars). The remaining clusters VII, VIII, IX, X, and XI were solitary (Table: 4.6.3 and Fig 4.6.1).

4.6.2. Cluster means:

The cluster means in respect of 19 characters and overall character wise scores across the 11 clusters are presented in (Table 4.6.4).

The present study revealed that cluster I had moderate mean value for all the characters under study. Cluster II had highest value for L/B ratio (2.86 cm) and cluster
III had lowest mean value for traits days to 50% flowering (76.6 days), leaf area index (67.73), flag-leaf breadth (1.49 cm) and grain length (7.5 mm.). Thus when observed for early flowering habit, cultivars in the cluster III (with lowest mean value for days to 50% flowering) had showed characteristic early flowering habit, indicating its significance in future breeding programme. While cluster IV had highest mean value for character days to 50% flowering (214.1 days); cluster V with highest mean value for percentage of viable seeds (93.55%) and spikelet density (15.8); cluster VI with highest mean value for characters panicles per plant (22.13) and tillers per plant (23.6) and lowest cluster mean value for plant height (87.33), grain breadth (2.85mm), length of the panicle (22.69 cm) and spikelet per panicle (142.6); cluster VII with highest mean value for characters grain length (8.86mm), harvest index (59.09), spikelet per plant (4993) and grain yield (1819.94); cluster VIII with highest cluster mean value for traits flag-leaf length (49.12 cm), spikelet per panicle (407.6) and length of the panicle (34.54 cm) and lowest mean value for tillers per plant (9.6) and panicle per plant (8); cluster IX had highest values for traits leaf area index (122.02 cm²), flag-leaf breadth (2.54 cm), total chlorophyll content (5.23mg/g) and grain breadth and lowest value for L/B ratio (2.04) and percentage of viable seeds (83.9%); cluster X with highest value for 1000 seeds weight (40.86 gm) and lowest values for harvest index (28.02) and spikelets per plant (1826.8) and cluster XI with highest value for plant height(200 cm) and lowest values for flag-leaf length (33.44 cm), total chlorophyll content(2.06 mg/g), 1000 seeds weight (14.81gm), spikelet density (5.44) and grain yield (302.08).

When observed for characters grain length, harvest index, spikelet per plant and grain yield, cultivar Ahumsali of the cluster VII (solitary cluster) had showed
highest value (8.86 mm, 59.09, 4993 and 1819.94 respectively) indicating its importance in future breeding programme. While solitary cluster VIII with cultivar *Bogisali* exhibited highest cluster mean for traits viz. spikelet per panicle, length of the panicle and flag-leaf length. Cluster IX with cultivar *Titaphuliabora* (which is also a solitary cluster) had showed highest cluster mean for characters viz. leaf area index, flag-leaf breadth, grain breadth and total chlorophyll content. Whereas solitary cluster X with cultivar *Pakhoribora* exhibited highest 1000 seeds weight.

Based on cluster means, characters were scored as the character with the higher magnitude in the desired direction was given the higher scores. Thus the cluster with highest score over all scores across 19 characters secured first rank and the cluster with the lowest score over all scores secured the 11th rank (Table 4.6.4). The cluster VII with overall score of 150 across the 19 characters gets first rank followed by cluster VIII with overall score 139, cluster VI with overall score 133, cluster IV with overall score 116, cluster V with overall score 112, cluster I and II with overall score 108, cluster IX with overall score 106, cluster X with overall score 102, cluster III with overall score 92 and cluster XI with overall score 60.

4.6.3. Intra and inter cluster distance:

The intra and inter cluster distances are given in Table: 4.6.5 and Fig. 4.6.2. The diversity among clusters showed a range of 7.29 to 25.12. Maximum differences among the cultivars within the same cluster were shown by cluster VI (12.02) followed by cluster V (11.88) and cluster IV (10.56). While minimum intra-cluster distance was shown by cluster I (8.21).
The highest inter cluster distance was observed between cluster XI and cluster X (25.12), followed by cluster XI and cluster IX (25), cluster XI and cluster III (24.8).

4.6.4. Relative contribution of different traits towards divergence:

Differences in proportion of contribution of nineteen (19) yield attributing character to total diversity was observed and are presented in Table: 4.6.6 and Fig 4.6.3. The selection and choice of parents mainly depends upon contribution of characters toward divergence. In the present investigation the highest contribution in manifestation of genetic divergence was exhibited by total chlorophyll content (ranked first 944 times out of total 2278 number of combination) contributing 41.44%, to divergence of cultivars. This was followed by days to 50% flowering (33.41%), spikelet per panicle (12.16%), 1000 seeds weight (4.92%), flag-leaf breadth (2.19%), and panicle per plant (1.32%). Flag-leaf length (0.00%) contributing least, towards genetic divergence among the nineteen yield attributing characters and was followed by grain breadth (0.04%).