# CHAPTER FIVE

## 5.1. DISCUSSION

Whenever any study utilizes a diversified set of germplasm represented in the world, regional and local breeding programs they are usually successful in developing a resistant variety (Bockelman, *et al*., 1981). In this research study, thirty six barley genotypes that have been retrieved and selected based on maturity and disease resistance level from Ethiopian gene bank were evaluated and shown to have differential response to many key important agronomic traits. For instance, the mean performance for days to heading, days to maturity, grain yield and other traits as well, depicted variability among genotypes in all environments. Interestingly there was a major rank change in the earliness of genotypes across environments. For example, G1 took 58 days to head in Mekelle, 71 days in Korem, 78 days in Debre-Birhan and 98 days in Istayish (Table 9) In Istayish, vegetative growth was shown to be longer probably due to the extensive rainfall period and cool temperature. This clearly shows that environment, apart from genetics, played a crucial role in determining characteristics of a given trait particularly earliness quality. These genotypes can grow in wide agro-ecology and can serve as parental material in the breeding program. It is normal to observe performance rank variation when genotypes are grown at several environments. This GxE interaction which is the major concern of any plant breeding program can complicate identification of better varieties and reduce gains if it is large. The purpose of any genotype test is to get accurate estimate of genotype performance within the limitations imposed by environmental growing conditions. Better adapted genotypes are, therefore, the most reliable way to increase productivity and secure food supply. Analysis of variance for individual locations verified that mean performance of genotypes specifically in days to heading, days maturity and grain yield from the sprayed and non-sprayed blocks were found non-significant (Appendix XVI, XVII and XVIII). Yet, incidence and severity percent of scald and net blotch as well as AUDPC was influenced by the spray of fungicide chemical and environments. Yitbarek, *et al*., (1998) n their research entitled “Variation in Ethiopian barley landrace populations for resistance to barley leaf scald and net blotch” have also found out that; application of fertilizer, the testing location and the geographical origin of the landrace populations were the major influential factor on the incidence and severity percent of scald and net blotch. This is an indication of largely environment effect as disease development is dependent on it. Genotypes planted at Debre-Birhan site were highly infected with scald disease compared to the rest of the locations (Figure 20). Generally out of thirty six genotypes only six were found resistant (Table 15). The rest were all susceptible. This could be due to favorable environmental conditions in the area (low temperature and high moisture) and the presence of high amount of over wintered spore as a result of repeated experiment in the site for barley. This site can be used as a high disease pressure site that can help to discriminate genotype performance against the disease. On the contrary, Istayish and Korem were less affected by the disease. This could again relate with unfavorable climatic conditions. Particularly in Korem the experimental site had very low stubble from previous cropping season and it was also surrounded by wheat experiment which is non-host for the pathogen. This condition might have contributed to the low rate of pathogen dissemination as spread of this pathogen to its neighboring plant is dependent mainly on rain splash. Mekelle, though not included in the spray treatment, disease severity level was very low. In terms of average grain yield, high score have been recorded in Debre-Birhan (6.13 $tha^{-1}$). In contrast Mekelle-09 had the lowest average grain yield (1.3$tha^{-1}$) (Table 8). The difference in climatic condition among testing locations had contributed a lot to the difference in yield. There are a number of methods to analyze GxE interactions; among others AMMI model is one. In this study, Additive Main Effect and multiplicative Interaction (AMMI) analysis, which is advocated by Gauch (Gauch, 1988; Gauch, 1992) as best tool to assess yield performance in multi-environment trails (METs), was applied further to identify genotypes with consistent performance in yield, days to heading, days to maturity and disease resistance in seven of the environments (Mekelle, Mekelle-09, Ayba-09, Korem, Debre-Birhan, Debre-Birhane-04 and Istayish. The results of AMMI analysis of variance indicated that most of the variations in grain yield, days to heading, days to maturity and disease resistance was caused largely by environments, genotypes and genotypes by environment interactions (Table 7, 10, 13 and 16). This result is in agreement with the research findings of (Farshadfa, 2011; Sadeghi, *et al.*, 2011). A large sum of squares for environments clearly indicated that the environments were diverse with high mean differences caused most of the variation in many of the traits including grain yield, days to heading, days to maturity and scald disease severity. From the explained total sum of square (TSS) percent it was found out that environment was the most important sources of variation, accounting for 73.36% of the total variation followed by GE interaction (19.55) and genotype (7.09%) (Table 7). The magnitude of genotypes by environment interaction was approximately 3 times higher than that of the genotype effect, signifying large differences in genotype responses to different environments. Implying it increases the possible advantage of breeding for specific adaptation. Besides the ongoing climatic change may cause these areas to vary widely in the future to come, therefore, it may require classification of the area in to sub-regions and thereby the breeding efforts focus on breeding for specific locations. Based on AMMI2 biplot (Figure 6, 8, 10 and 12) and genotype mean rank and AMMI stability value (ASV) (table 10, 13, 16 and 19), G1, G7 and G34 were found stably combine scald resistance, earliness, and high yield across all environments followed by G14 and G15. Generally, in Debre-birhan and Istayish genotypes were highly responsive and shown high variation in grain yield and scald disease severity percentage. Therefore, these environments contribute much to genotype by environment interaction (GxE). In terms of days to heading and days to maturity (Figure 8 and 10), Mekelle, Korem, Mekelle-09, Ayba-09 and Debre-birhan-04 had relatively big value of IPCA1and IPCA2 score, this indicating that the contribution of these sites to the overall GxE interaction was high. In both parameters, these locations can be used to discriminate the best performer genotypes and cull the inferior ones.

Considering genotype mean rank in response to the disease severity across five of the locations, attempts have been made to see which one remain consistently resistant in all environments. Based on Saari and Prescott description (Saari and Prescott, 1975), G1, G6, G7, G12, G14, G15 and G34, were found to be consistently resistant across all environments. However, in terms of earliness, G12, G14 and G15 were medium type maturing. But still they are candidate genotypes for future breeding program. On the contrary, G2, G3, G4, G5, G8, G9, G10, G11, G13, G16, G17 and G18; which were classified as resistant in 2004 growing season at Debre-Birhan were found to be susceptible in the same location in 2012. This might be as a result of a changing genetic composition in pathogen populations that end up with different genotypes showing resistance in different environments. Otherwise, the different environmental conditions in the two years could cause a difference in expression of the resistance in different varieties. Related results have been reported by (Kiros, *et al*., 2004).

In this study, two separate field blocks each with two replications were used as sprayed and non-sprayed blocks. Spray of anti-fungus chemical was used to control the pathogen to spot the impact of the disease from the non-sprayed block on different traits of the genotypes specifically on earliness character and yield. Besides, having sprayed and non-sprayed plots was helpful in the identification and selection process of resistant and susceptible genotypes easily. From the combined as well as individual analysis of variance shown in (Table 22, Appendix XVI, XVII and XVIII), there was no significant variation among genotypes for days to heading and days to maturity between the sprayed and non-sprayed blocks. However, regression analyses have depicted significant association between days to heading and scald disease in all locations except Korem. In Debre-Birhan  for example, despite the huge difference between the amount of disease severity in the sprayed and non-sprayed blocks, days to heading was not affected (both have 14.1%)(Figure 18B),. This kind of association seems deceptive because both susceptible and resistant genotypes had similar response in terms of earliness to variable severity percentage. Hence, the presence of heavy disease level in the non-sprayed block could not prove to have significant impact on the earliness character. Though the yield variation existed between sprayed and non-sprayed blocks in the individual site analysis showed non-significant, yield difference was considerable.  For example, an average of 0.14, 0.48 and 0.27 $tha^{-1}$ yield difference was observed between the sprayed and non-sprayed blocks at Korem, Debre-Birhan and Istayish sites, respectively. Likewise, Yitbarek and his colleagues (Yitbarek, *et al*., 1998) have reported 67% grain yield reduction due to scald under favorable environmental condition in Ethiopia. In fact this considerable grain yield difference needs serious attention in order to achieve food security, which is one of the millennium development goals, through development of resistant and high yielder genotypes. The relationship between days heading and scald disease in the sprayed and non-sprayed blocks was further explained by regression analysis for individual sites. Consequently, there was no significant relationship between days to heading and scald disease both in the sprayed and non-sprayed blocks in Korem site (Figure 13). This site had in fact very low disease pressure and only G22 was found to be seriously affected by the disease this may be associated with seed borne infection.

In Debre-Birhan on the other hand, analysis of variance (appendix IV and V) depicted that there was significant ($p<0.05$) negative relationship between days to heading and scald disease severity in the sprayed and non-sprayed blocks.  In other words, the association between early maturing genotypes with heading days below about 85.5 and scald disease severity percent greater than 60% (Figure 18A) was significant. In contrast, for the sprayed block, even though it appeared to be significant, days to heading of any level were not associated with scald disease severity above 60 percent. Generally the regression lines of figure 18A suggest that scald severity percent for the non-sprayed block were higher than those achieved with sprayed block across the range of days to heading. From the calculation of regression line, DH (NS) = 84.63 - 0.046 S (NS), days to heading declined on average by ~0.05. But one thing that needs to be considered is the effect was not caused solely by scald. Net-blotch was also involved in relatively higher percent in the non-sprayed block than in the sprayed block (Appendix XXI). Pinnschmidt *et al.*, 1995, cited in (Vollmer, *et al.*, 2005) reported that the presence of substantial amount of disease severity on leaves can facilitate leaf senescence and have an impact on leaf area dynamics, crop growth rate and yield. Indeed any damage to the leaf can have negative impact on the physiological process of the plant. However, this slight change in heading days cannot lead us to conclude that earliness character is the result of scald disease pressure. Yet other factors like in this case phytotoxicity have to be considered too. Though the symptom could not be identified at field condition because of the intermittent visits, there seems to be an effect from the chemical on days to heading and biological yield (BY) at Korem, Debre-Birhan and Istayish (Appendix XX, XXI and XXII). The application of anti-fungus chemical known as Tilt 250 EC containing active ingredient propiconazol 250 g/lit was made correctly, at a rate 0.5lit ha-1. But the application time might have been the problem; as hot and sunny day increase the ill effect of the chemical on the leaf. These results need to be verified possibly under screen house condition. With regard to grain yield, the analysis of variance table indicates that the relationship, GY(S) = 5.9 + 0.003 S(S) + 0.51(S), between grain yield and scald disease was not significant (Appendix XII). However, 0.51 $tha^{-1}$ yield was retained due to spray of chemical ($X_j$).The $R^2$ value showed that regression model explained 3.28% of the variance in grain yield, indicating that the model did not fit the data very well. G22 and G25 were identified as an unusual observation with low yield score. This could indicate that these observations are an outlier. Even if the relationship was found to be non-significant, 0.48$tha^{-1}$ average yield difference was observed between sprayed and non-sprayed blocks indicating that the disease is still economically important. G6, G7, G12, G14 and G15 which were consistently resistant from the non-sprayed plot had also shown better performance in terms of grain yield (Figure 20). The presence of high disease severity rate in this site was helpful in identifying genotype susceptibility towards the pathogen.

In Istayish site, there was significant negative association between days to heading and scald disease in the non-sprayed block but the reverse was true in the sprayed block. According to the regression equation, DH (NS)=106 - 0.124S (NS), days to heading declined on average by 0.12

day for every unit increase in scald disease (Figure 22). In fact only six of the genotypes were having a score greater than 60 percent severity levels (susceptible) (Figure 22). The rest were having a score below 60, meaning they are classified as resistant to moderately resistant according to Saari and Prescott description. However, regardless of the severity level, the overall pattern depicted that heading days linearly and negatively associated with scald disease. But still late type genotypes, as was observed in Debre-Birhan, were associated with little disease severity level G13 and G21 as compared with early heading genotypes which were associated with higher disease pressure like for example G10, G11, G23 and G35 (Figure 22). In terms of grain yield the impact of the disease was not significant from both treatments. However, the association was weak positive in the case of non-sprayed. This condition was a little bit strange but many of the genotypes were having disease score less than 60 percent implying they were not affected much by the disease. From the average data point, 0.27 $tha^{-1}$ grain yield difference have been observed from both treatments. In sum, Istayish site had very low disease pressure as compared with Debre-Birhan possibly due to cold dry condition of the area and less residuals from previous season that are useful for over-wintering the pathogen.

To understand better about the contribution of scald disease on the earliness character as well as yield, broad-sense heritability was estimated. The calculation of broad-sense heritability (H) based on entry mean across environments and individual plot for each trait (Table 22) depicted that the heritability of most of the traits was high, at least in part due to the diversified genetic background in the BCC collection. More specifically, the broad-sense heritability estimates of scald disease (0.23 on individual plot basis and 0.61 on entry mean across environment) indicate that resistance is influenced largely by the genotype. Likewise, the broad-sense heritability estimates of heading days (0.30 on individual plot basis and 0.67 on entry mean across environment) verified that earliness is strongly influenced by genotype. Leur and Gebre, ( 2003) has also reported that two varieties that had significant variation in scald severity was found not related with heading date. Further, Tsehaye, *et al*., (2012) have suggested in their paper "phenotypic and genotypic variation in flowering time in Ethiopian barley", that the interaction of drought resistance conditioning gene and flowering time could have a big role for a genotype to behave earliness. Further, the crop developmental stages seem also contributed some to the buildup of the pathogen on early maturing genotypes. As early maturing genotypes usually reach vegetative and heading stages earlier, it may expose itself to high pathogen spore levels which might end up with severe attack earlier than the late maturing genotype. The other possible reasons for many of the early type genotypes to behave susceptible in areas with high disease pressure could be the adaptation pattern they had before. Early maturing genotypes are normally chosen by farmers in drought prone areas for various reasons but the most important one is to escape moisture deficit. So, the amount of disease in these areas is comparatively smaller than high input areas like in this case Debre-Birhan. So planting of early maturing genotypes in the cooler area, which is supposed to have high disease pressure, can considerably affect and make early type varieties, not all, to behave susceptible. Similarly, (Fekadu and Parlevliet, 1997) have also suggested those late maturing genotypes, which are adapted to the highland area; characterized by relativeley cool, higher rainfall and higher disease pressure, are resistant to scald disease than early genotypes.

## CHAPTER SIX

## CONCLUSIONS AND RECOMMENDATIONS

### 6.1. CONCLUSIONS

This study has shown that environment was the predominant sources of variation for grain yield, scald disease severity level and maturity followed by genotype by environment interaction and genotypes. The existence of high genotype by environment interaction was identified from the differential response of genotypes rank across locations. Based on AMMI stability value (ASV) and yield stability index (YSI), G1, G5, G31, G33, G34 and G35 were found to be more consistent or less responsive to changing environment with relatively high yield as compared to the others followed by G3, G15 and G27. However, G23, G30 and G10 were high yielder but highly responsive to changing environment which clearly skewed to specific areas (specifically adapted). Location wise, Debre-birhan had the highest yield followed by Istayish and Korem; they were in fact the biggest contributor to the GXE variation. In contrast Mekelle had the poorest yield this could be related with moisture deficit problem which is common in the area. In the sense of specific adaptation, the best candidate genotypes in Debre-Birhan are G6, G13, G17 and G27, in Istayish G22 and G28, in Korem, G7, G20 and G31, in Mekelle, G3, G4 and G16 and in Ayba G2 and G10 were best performer.

In conclusion:

1. From the perspective of earliness, G1, G7, G27, G29, G30 and G35 had shown relative earliness across environments followed by G2, G23, G26 and G33. Location wise, Istayish had the highest heading day and contributed a lot to the variation followed by Debre-birhan and Debre-birhan-04. On the contrary Mekelle, Mekelle-09, Korem and Ayba-09 had short heading day.
2. For disease response across environments, G1, G6, G7, G12, G14 and G15 was identified as the most stable resistance genotypes. Location wise Debre-birhan had the highest severity level which is best for disease testing. Mekelle and Korem had the lowest severity level this could relate with moisture deficit as scald disease is checked by hot and dry condition.

3. Magnitude of genotypes by environment interaction ($GxE_{var}$) variance was greater than that of genotypes variance ($G_{var}$). Though it requires further investigation, results suggested that three mega environments have been detected:

   3.1. Mekelle, Korem & Ayba (mid altitude, unreliable R.F)
   3.2. Debre-Birhan (high altitude, steady R.F) and
   3.3. Istayish (high altitude, moderate R.F)

4. There was considerable variation among genotypes for all measured traits.
5. Genotypes maturity was consistent across sprayed (low disease.) & non-sprayed (high disease) plots. As an example, the average heading day difference in Korem between sprayed and non-sprayed blocks was 72 and 73 respectively. Heritability estimates of heading days (0.30 on individual plot basis and 0.67 on entries mean across environment) (table 7) verified that earliness is strongly influenced by genotype. Besides day to heading and Scald disease severity % were not significantly correlated. Therfore, no significant effect of scald on maturity i.e, earliness character is mainly attributed to genetic effect.
6. Sprayed plot yielded up to 0.5 tonne per hectar more than non-sprayed plot. This shows a major effect of scald on yield.

## 6.2. RECOMMENDATIONS

After a thorough analysis of data, the following recommendations are hereby made:

1. G1, G6, G7, G15 and G34 should be widely tested for possible recommendation to be used by farmers at all locations. They can also be included in the breeding program to further test them across seasons as stability across season is much more important for the farmer than locations.

2. Furthermore, some of the genotypes with excellent quality in terms of disease resistance but low yielding can also be used as parental material for further crossing to come up with elite genotypes combined resistance and high yielder.

3. These genotypes have to be tested in multiple locations and years in the hot spot area to verify their stability. Because assessment of GxE effects may not be effective with just limited number of years and locations, and the estimation is inflated by non-repeatable effects.

4. Furthermore, as the disease intensity varies across environments, genotype performance evaluation may be of challenging. Therefore, to alleviate such kind of problem, inoculation of genotypes in nursery area should be done in addition to multi-location tests for better understanding of genotypes response against the disease.

5. Besides, multi-environments testing of more of the barley collection may identify additional genotypes with disease resistance and early maturity.

6. Classification of the area in to mega environments may help to increase efficiency in the development of varieties.

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## APPENDIX TABLES

APPENDIX I: ANOVA Table of Regression for DH vs. scald disease in Mekelle, non-sprayed

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 1325.03 | 1325.03 | 8.26 | 0.007 |
| Residual Error | 34 | 5455.34 | 160.45 | | |
| Total | 35 | 6780.37 | | | |

$R^2$=19.54

APPENDIX II: ANOVA Table of Regression for DH vs. scald disease in Korem, sprayed

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 0.80 | 0.80 | 0.01 | 0.937 |
| Residual Error | 34 | 4429 | 130.3 | | |
| Total | 35 | 4430 | | | |

$R^2$=0.0%

APPENDIX III: ANOVA Table of regression for DH vs. scald disease in Korem, Non-sprayed

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 3.70 | 3.70 | 0.03 | 0.875 |
| Residual Error | 34 | 4992.9 | 146.8 | | |
| Total | 35 | 4996.6 | | | |

$R^2$ = 0.1%

APPENDIX IV: ANOVA Table of Regression for scald disease vs. DH from sprayed blocks in Debre-Birhan

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 2744.5 | 2744.5* | 5.59 | 0.024 |
| Residual Error | 34 | 16681.3 | 490.6 | | |
| Total | 35 | 19425.8 | | | |

$R^2$ = 14.1%

APPENDIX V: ANOVA Table of Regression for scald disease vs. DH in Debre-Birhan, Non-sprayed

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 3940.9 | 3940.9* | 5.6 | 0.024 |
| Residual Error | 34 | 23925.2 | 703.7 | | |
| Total | 35 | 27866.1 | | | |

$R^2$ = 14.1%

APPENDIX VI: ANOVA Table of Regression for difference in days to heading (DHDiff) vs. scald in Debre-Birhan, from non-sprayed

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 35.047 | $35.047^{ns}$ | 3.52 | 0.069 |
| Residual Error | 34 | 338.674 | 9.961 | | |
| Total | 35 | | | | |

$R^2$ = 9.4%

APPENDIX VII: ANOVA Table of Regression for difference in days to heading (DHDiff) vs. scald in Debre-Birhan, from sprayed block

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 2.55 | $2.55^{ns}$ | 0.23 | 0.632 |
| Residual Error | 34 | 371.28 | 10.92 | | |
| Total | 35 | | | | |

$R^2$=0.7%

APPENDIX VIII: ANOVA Table of Regression for GY vs. DH in Debre-Birhan, from non-sprayed block

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 0.497 | $0.497^{ns}$ | 0.48 | 0.495 |
| Residual Error | 34 | 35.53 | 1.045 | | |
| Total | 35 | | | | |

$R^2$=1.4%

APPENDIX IX: ANOVA Table of Regression for GY vs. DH in Debre-Birhan, from sprayed block

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 1.818 | $1.818^{ns}$ | 1.38 | 0.248 |
| Residual Error | 34 | 44.744 | 1.316 | | |
| Total | 35 | | | | |

$R^2$=3.9%

APPENDIX X: ANOVA Table of Regression for DM vs. Scald disease from sprayed in Debre-Birhan

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 35.7 | $35.66^{ns}$ | 1.62 | 0.211 |
| Residual Error | 34 | 747 | 21.98 | | |
| Total | 35 | 783 | | | |

$R^2$ = 4.6%

APPENDIX XI: ANOVA Table of Regression for DM vs. Scald disease from non-sprayed in Debre-Birhan

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 0.16 | $0.16^{ns}$ | 0.01 | 0.919 |
| Residual Error | 34 | 530 | 15.58 | | |
| Total | 35 | 530 | | | |

$R^2$ = 0.0%

APPENDIX XII ANOVA table of regression for GY vs. Scald disease from sprayed and non-sprayed in Debre-Birhan

| Source | DF | Seq SS | Adj SS | Adj MS | F | P |
|---|---|---|---|---|---|---|
| Regression | 2 | 2.8257 | 2.8257 | 1.41285 | 1.16827 | 0.316978 |
| SSP | 1 | 0.2667 | 0.4611 | 0.46107 | 0.38125 | 0.538968 |
| Trt | 1 | 2.559 | 2.559 | 2.55901 | 2.11602 | 0.150299 |
| Error | 69 | 83.4455 | 83.4455 | 1.20935 | | |
| Lack-of-Fit | 66 | 81.4675 | 81.4675 | 1.23436 | 1.87218 | 0.339513 |
| Pure Error | 3 | 1.9779 | 1.9779 | 0.65932 | | |
| Total | 71 | 86.2712 | | | | |

$R^2$= 3.28%

APPENDIX XIII: ANOVA Table of Regression for DH vs. scald disease in Istayish, sprayed

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 11.28 | 11.28 | 0.3 | 0.588 |
| Residual error | 34 | 1280.93 | 37.67 | | |
| Total | 35 | 1292.21 | | | |

$R^2$=0.9%

APPENDIX XIV: ANOVA Table of Regression for DH vs. scald disease in Istayish, Non-sprayed

| Source | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 258.16 | 258.16** | 10.34 | 0.003 |
| Residual error | 34 | 848.63 | 24.96 | | |
| Total | 35 | 1106.79 | | | |

$R^2$=22.3%

APPENDIX XV :ANOVA for 14 traits from **Mekelle** site, 2012.

| Sources of variation | DF | Mean square | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DH | DM | Scald | SDI% | AUDPC | NB | PH(cm) | BY $tha^{-1}$ | GY $tha^{-1}$ | HI% | TC | SL | SPS | TSW |
| Rep | 1 | 381.9* | 50.7$^{ns}$ | 2$^{ns}$ | 39$^{ns}$ | 875$^{ns}$ | 55$^{ns}$ | 19 | 0.01$^{ns}$ | 0.32$^{ns}$ | 29$^{ns}$ | 1.51$^{ns}$ | 4.06* | 27.36$^{ns}$ | 276.98** |
| Blocks/Rep | 10 | 76.5$^{ns}$ | 25.7$^{ns}$ | 32$^{ns}$ | 74$^{ns}$ | 6156$^{ns}$ | 543* | 53* | 9.44$^{ns}$ | 0.31* | 54** | 0.55$^{ns}$ | 0.46$^{ns}$ | 53.14$^{ns}$ | 13.01$^{ns}$ |
| Genotype | 35 | 276.6*** | 91.9*** | 27$^{ns}$ | 63$^{ns}$ | 6653$^{ns}$ | 221$^{ns}$ | 92*** | 6.78$^{ns}$ | 0.47*** | 33*** | 2.52*** | 2.09*** | 194.78*** | 125.12*** |
| RCB Error | 36 | --- | 29.7 | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | 31.52 |
| Lattice Residual | 14 | 60.3 | 26.5 | 28 | 68 | 5365 | 161 | 22 | 3.90 | 0.11 | 17 | 0.25 | 0.29 | 27.09 | 17.21 |
| LEE | | 70.7 | - | 126.7 | 86.6 | - | 207.6 | 35.8 | - | 0.19 | 32.4 | 0.41 | 0.44 | 35.7 | - |
| Total | 59 | | | | | | | | | | | | | | |

DF= degree freedom, $^{ns}$ = non significant at p=0.05, *significant at p<0.05, **significant at p<0.01, ***significant at p<0.001

APPENDIX XVI :ANOVA ofor 14 traits from **Korem** site, 2012.

| Sources of variation | DF | Mean square | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DH | DM | Scald | SDI% | AUDPC | NB | PH | BY $tha^{-1}$ | GY $tha^{-1}$ | HI% | TC | SL | SPS | TSW |
| Mgt | 1 | 20.2$^{ns}$ | 16.2$^{ns}$ | 17107** | 27236** | 462856** | 16808* | 1487$^{ns}$ | 49.54$^{ns}$ | 0.50$^{ns}$ | 2839$^{ns}$ | 8.51$^{ns}$ | 9.61* | 1.2$^{ns}$ | 5.65$^{ns}$ |
| Rep/Mgt | 2 | 36.8* | 45.0$^{ns}$ | 76$^{ns}$ | 54.90$^{ns}$ | 3844$^{ns}$ | 186$^{ns}$ | 322** | 22.62*** | 2.16*** | 198* | 0.88$^{ns}$ | 0.48* | 23.3$^{ns}$ | 5.71$^{ns}$ |
| Blocks/Rep/Mgt | 20 | 8.7$^{ns}$ | 50.2$^{ns}$ | 74$^{ns}$ | 108$^{ns}$ | 2516$^{ns}$ | 172$^{ns}$ | 35$^{ns}$ | 1.78$^{ns}$ | 0.15$^{ns}$ | 37$^{ns}$ | 0.85$^{ns}$ | 0.10$^{ns}$ | 20.5$^{ns}$ | 4.85$^{ns}$ |
| Genotype | 35 | 497.4*** | 557.9*** | 499* | 645*** | 7356*** | 163$^{ns}$ | 293*** | 3.53*** | 2.76*** | 296* | 6.67*** | 2.73*** | 262.2*** | 102.52*** |
| Mgt x Genotype | 35 | 25.9*** | 48.9$^{ns}$ | 306*** | 303* | 7356*** | 104$^{ns}$ | 40$^{ns}$ | 1.52$^{ns}$ | 0.12$^{ns}$ | 80$^{ns}$ | 0.67$^{ns}$ | 0.13$^{ns}$ | 27.2$^{ns}$ | 6.98$^{ns}$ |
| Residual | 50 | 7.3 | 38.2 | 111 | 167 | 2519 | 158 | 35.24 | 1.01 | 0.203 | 55 | 0.67 | 0.14 | 17.11 | 5.407 |
| LEE | - | 7.6 | 40.8 | - | - | 2518 | 162 | 35.16 | 1.14 | - | - | 0.71 | - | 17.91 | - |
| Total | 143 | | | | | | | | | | | | | | |

DF= degree freedom, $^{ns}$ = non significant at p=0.05, *significant at p<0.05, **significant at p<0.01, ***significant at p<0.001

APPENDIX XVII :ANOVA for 14 traits from **Debre-Birhan** site, 2012.

| Sources of variations | DF | Mean square | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DH | DM | Scald | SDI% | AUDPC | NB | PH | BY $tha^{-1}$ | GY $tha^{-1}$ | HI% | TC | SL | SPS | TSW |
| Mgt | 1 | $15.9^{ns}$ | $390.3^{ns}$ | 75170** | 126452** | 1308618** | $4590^{ns}$ | $369^{ns}$ | $93.95^{ns}$ | $4.75^{ns}$ | 8153* | $8.39^{ns}$ | $0.22^{ns}$ | $17.84^{ns}$ | 776.92* |
| Rep/Mgt | 2 | 22.8* | 61.6* | $358^{ns}$ | $399^{ns}$ | $2011^{ns}$ | $347^{ns}$ | 225** | 30.02** | 5.72** | $211^{ns}$ | 52.45** | 1.55* | 445.94** | $21.14^{ns}$ |
| Blocks/Rep/Mgt | 20 | $5.2^{ns}$ | $16.4^{ns}$ | $151^{ns}$ | $204^{ns}$ | $14460^{ns}$ | $297^{ns}$ | $38^{ns}$ | $3.71^{ns}$ | $0.67^{ns}$ | $67^{ns}$ | $8.402^{ns}$ | $0.28^{ns}$ | $26.93^{ns}$ | $6.20^{ns}$ |
| Genotype | 35 | 25.6*** | 54.4*** | 2055*** | 2750*** | $16529^{ns}$ | 5056*** | 322*** | 8.58*** | 4.19*** | 268*** | 21.46*** | 2.76*** | 743.14*** | 72.06*** |
| Mgt x Genotype | 35 | 10.4* | 20.1* | 655*** | 636** | $12987^{ns}$ | $662^{ns}$ | $29^{ns}$ | $2.87^{ns}$ | 0.86* | $88^{ns}$ | $5.69^{ns}$ | $0.35^{ns}$ | $19.99^{ns}$ | $7.62^{ns}$ |
| Residual | 50 | 5.1 | 11.1 | 154 | 297 | 9830 | 422 | 22 | 1.89 | 0.40 | 70 | 5.97 | 0.321 | 26.05 | 4.4 |
| LEE | - | 5.2 | 12.1 | 152 | 258 | 10733 | 371 | 25 | 2.16 | 0.44 | 69 | 6.46 | - | 26.3 | 4.76 |
| Total | 143 | | | | | | | | | | | | | | |

DF= degree freedom, $^{ns}$ = non significant at p=0.05, *significant at p<0.05, **significant at p<0.01, ***significant at p<0.001

APPENDIX XVIII :ANOVA for 14 traits from **Istayish** site, 2012.

| Sources of variations | DF | Mean square | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | DH | DM | Scald | SDI% | AUDPC | NB | PH | BY $tha^{-1}$ | GY $tha^{-1}$ | HI% | TC | SL | SPS | TSW |
| Mgt | 1 | $9.5^{ns}$ | $52.2^{ns}$ | 32101* | 22972* | $12741^{ns}$ | $14887^{ns}$ | $92^{ns}$ | $90.85^{ns}$ | $2.66^{ns}$ | 4662* | $41.66^{ns}$ | $2.37^{ns}$ | $635.3^{ns}$ | $41.36^{ns}$ |
| Rep/Mgt | 2 | 317.1* | $226.8^{ns}$ | 1067** | 1077* | 318535*** | 1658* | 1152** | $8.11^{ns}$ | 4.51** | $144^{ns}$ | 33.07* | 9.87* | 245.3* | $64.62^{ns}$ |
| Blocks/Rep/Mgt | 20 | $78.3^{ns}$ | 96.6* | $151^{ns}$ | $283^{ns}$ | $7376^{ns}$ | $311^{ns}$ | $111^{ns}$ | $2.59^{ns}$ | $0.57^{ns}$ | $127^{ns}$ | $8.51^{ns}$ | $2.63^{ns}$ | $63.8^{ns}$ | $21.82^{ns}$ |
| Genotype | 35 | 101.1* | 96.7** | $401^{ns}$ | $375^{ns}$ | $5060^{ns}$ | 1350*** | 124* | $2.87^{ns}$ | 1.71** | $129^{ns}$ | $10.58^{ns}$ | 4.89* | $165.3^{ns}$ | $20.45^{ns}$ |
| Mgt x Genotype | 35 | $38.0^{ns}$ | $41.1^{ns}$ | $353^{ns}$ | $303^{ns}$ | $6808^{ns}$ | $367^{ns}$ | $73^{ns}$ | $2.12^{ns}$ | $0.85^{ns}$ | $64^{ns}$ | $4.26^{ns}$ | $2.01^{ns}$ | $145.8^{ns}$ | $9.37^{ns}$ |
| Residual | 50 | 48.2 | 39.0 | 364 | 313 | 9200 | 375 | 66 | 3.12 | 0.97 | 126 | 6.69 | 2.43 | 150.30 | 21.10 |
| LEE | - | 53.5 | 45.6 | - | 303 | 8822 | 353 | 73 | 2.94 | 0.78 | 126 | 7.10 | 2.48 | 92.08 | 21.30 |
| Total | 143 | | | | | | | | | | | | | | |

DF= degree freedom, $^{ns}$ = non significant at p=0.05, *significant at p<0.05, **significant at p<0.01, ***significant at p<0.001

APPENDIX XIX: Mean of 14 traits from non-sprayed plot **Mekelle** site 2012.

| Gen | DH | DM | Scald | SDI% | AUDPC | NB | PH | BY ($tha^{-1}$) | GY($tha^{-1}$) | HI% | TC | SL | SPS | TSW(g) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 58 | 96 | 9.7 | -0.03 | 0.0 | 22.06 | 73.63 | 6.32 | 1.5 | 22.14 | 4.09 | 5.57 | 36 | 40.33 |
| 2 | 65 | 101 | 44.6 | 24.85 | 2.5 | 17.66 | 71.58 | 4.86 | 1.16 | 18.06 | 3.55 | 5.5 | 45 | 32.79 |
| 3 | 90 | 116 | 0.0 | 0.02 | 92.5 | 37.7 | 65.85 | 6.17 | 1.29 | 17.37 | 5.09 | 6.77 | 19 | 56.5 |
| 4 | 92 | 110 | 0.0 | 0.00 | 0.0 | 54.78 | 69.55 | 2.33 | 0.68 | 15.46 | 4.24 | 6.44 | 19 | 51.28 |
| 5 | 53 | 99 | 0.0 | -0.02 | 0.0 | 21.18 | 74.04 | 6.95 | 1.6 | 19.38 | 5.47 | 5.6 | 36 | 31.98 |
| 6 | 58 | 93 | 0.0 | 0.00 | 0.0 | 20.78 | 67.85 | 7.2 | 2.54 | 33.7 | 6.04 | 7.33 | 25 | 58.28 |
| 7 | 65 | 91 | 1.5 | -0.28 | 0.0 | 44.36 | 71.15 | 3.19 | 0.92 | 21.78 | 5.53 | 8.55 | 22 | 47.26 |
| 8 | 77 | 104 | 0.0 | -0.26 | 82.5 | 45.97 | 69.16 | 4.11 | 1.1 | 19.08 | 4.89 | 6.43 | 57 | 41.22 |
| 9 | 50 | 91 | 0.6 | 0.20 | 5.0 | 13.5 | 89.46 | 8.67 | 2.2 | 22.97 | 5.33 | 6.48 | 51 | 35.43 |
| 10 | 49 | 89 | 0.0 | 1.35 | 110.0 | 30.78 | 86.34 | 7.78 | 1.87 | 21.71 | 5.41 | 6.01 | 49 | 38.4 |
| 11 | 66 | 90 | 4.6 | 1.77 | 80.0 | 40.48 | 75.34 | 7.12 | 1.53 | 17.98 | 4.42 | 6.86 | 42 | 45.41 |
| 12 | 92 | 112 | 0.0 | 0.00 | 0.0 | 38.38 | 78.77 | 4.67 | 1.06 | 16.53 | 4.13 | 7.42 | 22 | 57.14 |
| 13 | 92 | 113 | 1.1 | 0.00 | 0.0 | -0.66 | 70.07 | 5.8 | 1.14 | 22.45 | 3.93 | 5.58 | 31 | 44.57 |
| 14 | 88 | 110 | 0.0 | 0.00 | 77.5 | 26.55 | 64.09 | 2.33 | 0.52 | 9.47 | 3.05 | 6.28 | 20 | 44.3 |
| 15 | 67 | 98 | 0.0 | 1.76 | 0.0 | 50.41 | 54.96 | 3.34 | 0.55 | 12.27 | 5.11 | 5.79 | 31 | 36.6 |
| 16 | 71 | 100 | 1.0 | -0.43 | 40.0 | 34.69 | 64.87 | 5.92 | 0.86 | 13.95 | 3.99 | 6.45 | 41 | 38.07 |
| 17 | 58 | 99 | 0.0 | 0.00 | 14.7 | 32.39 | 80.51 | 9.67 | 1.61 | 12.8 | 4.69 | 6.16 | 42 | 33.08 |
| 18 | 63 | 93 | 30.6 | 16.81 | 85.0 | 33.2 | 76.63 | 9.67 | 1.94 | 11.7 | 4.48 | 6.26 | 44 | 37.48 |
| 19 | 84 | 108 | 3.6 | -0.15 | 0.0 | 24.42 | 62.71 | 5.66 | 0.6 | 13.42 | 4.88 | 6.29 | 41 | 38.31 |
| 20 | 78 | 100 | 20.2 | 7.64 | 112.5 | 31.02 | 62.68 | 6.02 | 0.83 | 10.82 | 4.24 | 7.46 | 20 | 49.78 |
| 21 | 93 | 112 | 0.6 | 1.49 | 0.0 | 56.55 | 67.73 | 2.97 | 0.37 | 14 | 3.28 | 6.76 | 41 | 53.98 |
| 22 | 67 | 91 | 61.0 | 0.55 | 150.0 | 19.84 | 71.01 | 5.37 | 0.81 | 16.79 | 4.26 | 5.68 | 42 | 41.45 |
| 23 | 65 | 88 | 16.7 | 3.08 | 0.0 | 20.04 | 78.56 | 9.21 | 1.89 | 20.6 | 5.26 | 6.6 | 45 | 41.47 |
| 24 | 71 | 96 | 2.9 | 0.00 | 125.0 | 47.49 | 74.51 | 4 | 0.51 | 16.07 | 6.02 | 8.55 | 20 | 54.25 |
| 25 | 66 | 98 | 0.0 | -1.74 | 0.0 | 37.65 | 76.97 | 7.69 | 2.27 | 26.94 | 5.24 | 6.64 | 50 | 41.37 |
| 26 | 54 | 94 | 2.1 | -1.33 | 0.0 | 36.76 | 64.26 | 6.86 | 2.17 | 29.61 | 3.9 | 6 | 40 | 28.83 |
| 27 | 56 | 93 | 24.6 | 24.95 | 0.0 | 23.29 | 72.13 | 6.06 | 1.46 | 23.39 | 4.94 | 8.09 | 22 | 51.54 |
| 28 | 71 | 104 | 12.1 | 0.00 | 0.0 | 24.96 | 74.17 | 8.2 | 2.53 | 33.23 | 3.95 | 4.31 | 27 | 47.36 |
| 29 | 75 | 101 | 3.4 | 0.00 | 60.0 | 34.96 | 73.87 | 8.1 | 2.13 | 28.65 | 2.75 | 4.31 | 47 | 43.36 |
| 30 | 61 | 96 | 3.3 | 0.00 | 30.0 | 36.96 | 80.41 | 6.67 | 2.04 | 30.02 | 4.35 | 6.47 | 45 | 43.36 |
| 31 | 62 | 88 | 66.6 | 66.30 | 104.5 | -0.66 | 70.67 | 12 | 2.75 | 24.83 | 9.93 | 6.84 | 21 | 38.37 |
| 32 | 51 | 94 | 27.7 | 14.13 | 25.0 | 18.59 | 90.25 | 8.08 | 1.69 | 17.99 | 4.62 | 7.67 | 39 | 34.69 |
| 33 | 75 | 103 | 6.4 | 0.00 | 0.0 | 16.63 | 81.31 | 7.5 | 1.98 | 24.93 | 4.36 | 5.2 | 39 | 47 |
| 34 | 51 | 96 | 11.3 | 3.22 | 0.0 | 13.41 | 81.55 | 6.58 | 1.53 | 21.21 | 4.44 | 5.85 | 38 | 32.87 |
| 35 | 59 | 96 | 38.1 | 17.95 | 107.5 | 21.61 | 84.14 | 9.34 | 1.69 | 16.16 | 4.64 | 6.23 | 57 | 32.38 |
| 36 | 45 | 94 | 41.7 | 49.20 | 117.5 | 21.63 | 77.06 | 9.33 | 1.89 | 17.42 | 5.98 | 7.85 | 21 | 48.08 |
| Mean | 67.28 | 98.76 | 12.11 | 6.42 | 39.50 | 29.15 | 73.55 | 6.55 | 1.48 | 19.86 | 4.74 | 6.45 | 35.8 | 42.74 |
| LSD (5%) | 18.51 | 12.28 | 13.27 | 20.71 | 183.82 | 30.29 | 11.1 | 4.97 | 0.77 | 9.83 | 1.43 | 1.3 | 12.4 | 9.89 |
| CV% | 11.54 | 5.21 | 43.67 | 128.5 | 152 | 43.58 | 6.33 | 31.8 | 21.93 | 20.76 | 12.7 | 8.46 | 14.6 | 9.71 |

APPENDIX XX:  Mean of 14 traits across sprayed and non-sprayed plots from **Korem** site 2012.

| | DH | | DM | | Scald | | SDI% | | AUDPC | | NB | | PH | | BY (tha$^{-1}$) | | GY (tha$^{-1}$) | | HI% | | TC | | SL | | SPS | | TSW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gen** | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP |
| 1 | 70.29 | 71.48 | 102.36 | 103.58 | 15.75 | 30.48 | 22.58 | 43.82 | 70.65 | 141.29 | 14.39 | 28.94 | 91.73 | 99.84 | 9.11 | 11.44 | 4.89 | 5.01 | 57.32 | 43.60 | 3.54 | 3.61 | 5.41 | 5.95 | 30.82 | 29.91 | 51.59 | 51.59 |
| 2 | 70.49 | 71.95 | 99.47 | 104.72 | 17.17 | 33.79 | 18.91 | 35.10 | 88.63 | 177.26 | 10.91 | 21.79 | 87.30 | 91.43 | 9.17 | 9.85 | 3.68 | 3.48 | 44.20 | 40.57 | 4.30 | 4.38 | 4.99 | 5.16 | 39.03 | 35.43 | 51.60 | 50.23 |
| 3 | 96.36 | 95.98 | 121.87 | 129.68 | 15.29 | 30.38 | 20.58 | 38.64 | 76.98 | 153.95 | 10.91 | 21.25 | 80.50 | 87.60 | 8.71 | 9.07 | 3.84 | 3.81 | 44.53 | 39.64 | 5.84 | 5.78 | 6.98 | 7.16 | 20.13 | 20.12 | 58.05 | 56.23 |
| 4 | 70.52 | 70.97 | 101.86 | 102.24 | 26.83 | 54.34 | 35.65 | 51.09 | 143.56 | 286.55 | 15.91 | 31.60 | 96.26 | 99.72 | 7.69 | 8.00 | 3.51 | 3.31 | 46.97 | 39.44 | 3.44 | 3.43 | 4.72 | 4.85 | 45.05 | 40.17 | 49.76 | 47.57 |
| 5 | 62.81 | 62.00 | 97.97 | 90.58 | 4.83 | 9.37 | 10.14 | 19.31 | 20.78 | 41.55 | 8.08 | 16.40 | 88.62 | 92.46 | 8.45 | 8.37 | 4.19 | 4.08 | 50.09 | 47.27 | 6.54 | 6.58 | 5.23 | 5.45 | 32.40 | 32.61 | 45.73 | 44.09 |
| 6 | 78.69 | 70.99 | 119.74 | 113.24 | 0.12 | -0.86 | 4.14 | 3.14 | -5.07 | -10.16 | 2.98 | 5.99 | 72.13 | 68.36 | 7.55 | 8.06 | 2.61 | 2.51 | 35.38 | 32.09 | 4.63 | 4.68 | 6.80 | 7.55 | 31.28 | 24.65 | 62.87 | 65.11 |
| 7 | 75.50 | 74.00 | 109.48 | 112.85 | 4.56 | 8.86 | 5.72 | 15.38 | 14.17 | 28.34 | 16.24 | 32.49 | 80.94 | 88.78 | 6.57 | 7.88 | 2.51 | 2.52 | 40.87 | 30.84 | 4.96 | 4.70 | 6.28 | 6.82 | 17.54 | 18.79 | 56.74 | 56.70 |
| 8 | 73.45 | 73.97 | 105.34 | 106.50 | 8.48 | 17.17 | 16.20 | 34.96 | 48.15 | 96.31 | 16.01 | 31.85 | 87.75 | 91.72 | 7.73 | 9.20 | 3.63 | 3.72 | 48.71 | 44.15 | 4.11 | 4.57 | 4.79 | 4.74 | 42.75 | 42.80 | 48.85 | 48.95 |
| 9 | 53.32 | 52.50 | 87.74 | 85.45 | 6.60 | 13.76 | 6.52 | 15.80 | 26.50 | 53.01 | 11.26 | 21.80 | 95.21 | 100.90 | 7.57 | 8.52 | 4.49 | 4.55 | 56.39 | 49.53 | 4.15 | 5.27 | 5.54 | 6.03 | 37.16 | 37.90 | 50.98 | 51.55 |
| 10 | 51.99 | 51.99 | 94.23 | 98.52 | 7.64 | 16.71 | 8.26 | 22.10 | 35.59 | 70.60 | 22.01 | 43.66 | 97.29 | 99.31 | 7.40 | 7.84 | 4.09 | 4.07 | 54.83 | 48.46 | 3.61 | 4.22 | 5.71 | 5.59 | 40.26 | 35.44 | 49.51 | 49.24 |
| 11 | 70.27 | 70.52 | 100.84 | 101.85 | 17.14 | 34.75 | 23.63 | 51.57 | 79.05 | 158.11 | 8.18 | 16.46 | 91.30 | 91.60 | 8.41 | 8.61 | 4.00 | 3.89 | 47.39 | 42.90 | 3.06 | 3.48 | 5.37 | 5.60 | 39.42 | 41.29 | 52.48 | 52.46 |
| 12 | 76.65 | 76.51 | 112.36 | 113.02 | 4.43 | 8.52 | 7.80 | 15.75 | 15.70 | 31.39 | 2.83 | 5.55 | 86.27 | 93.50 | 7.41 | 8.50 | 2.65 | 2.51 | 37.08 | 28.85 | 4.90 | 5.27 | 6.18 | 6.44 | 16.80 | 17.83 | 56.32 | 58.38 |
| 13 | 91.99 | 91.52 | 127.52 | 123.39 | 4.69 | 9.16 | 9.04 | 18.97 | 20.92 | 41.85 | 16.15 | 32.44 | 72.75 | 73.11 | 6.30 | 7.37 | 1.91 | 1.80 | 33.62 | 26.31 | 4.78 | 4.07 | 6.16 | 6.36 | 31.06 | 32.49 | 52.92 | 50.85 |
| 14 | 90.19 | 89.49 | 125.38 | 125.53 | 5.86 | 11.98 | 6.92 | 13.35 | 51.15 | 102.32 | 21.67 | 43.29 | 93.99 | 97.90 | 7.30 | 9.08 | 2.53 | 2.32 | 39.17 | 29.98 | 3.98 | 4.64 | 7.52 | 7.71 | 26.62 | 23.71 | 61.38 | 60.50 |
| 15 | 72.06 | 71.52 | 103.03 | 100.99 | 1.47 | 3.56 | -0.16 | -0.62 | 12.00 | 24.01 | 8.42 | 16.25 | 79.66 | 86.67 | 8.09 | 7.90 | 3.16 | 3.33 | 39.22 | 42.22 | 4.67 | 4.54 | 5.85 | 6.05 | 24.33 | 28.60 | 51.94 | 51.65 |
| 16 | 91.97 | 91.51 | 127.52 | 124.55 | 10.02 | 21.52 | 10.34 | 23.18 | 52.34 | 104.11 | 8.17 | 16.10 | 85.20 | 86.84 | 7.48 | 7.93 | 2.18 | 2.18 | 30.97 | 27.89 | 3.68 | 3.79 | 5.61 | 5.58 | 32.50 | 32.55 | 49.37 | 48.73 |
| 17 | 70.01 | 69.54 | 99.38 | 96.89 | 9.01 | 18.55 | 10.26 | 21.76 | 52.05 | 104.11 | 8.09 | 16.40 | 93.28 | 93.22 | 8.98 | 8.90 | 3.77 | 3.65 | 43.31 | 42.05 | 4.38 | 3.84 | 4.72 | 5.19 | 34.50 | 31.69 | 48.39 | 50.85 |
| 18 | 71.39 | 70.53 | 103.40 | 102.05 | 20.06 | 39.82 | 20.48 | 38.03 | 87.45 | 174.90 | 17.24 | 34.49 | 99.81 | 102.48 | 10.04 | 9.79 | 3.94 | 3.54 | 40.59 | 39.05 | 4.57 | 5.04 | 4.60 | 4.98 | 35.83 | 39.53 | 55.75 | 54.88 |
| 19 | 81.10 | 86.53 | 116.93 | 116.63 | 15.19 | 28.70 | 22.85 | 46.09 | 79.13 | 158.84 | 13.05 | 26.49 | 83.18 | 86.47 | 7.53 | 7.42 | 2.98 | 3.08 | 37.91 | 40.62 | 4.50 | 4.34 | 5.94 | 6.38 | 35.76 | 36.94 | 50.45 | 50.36 |
| 20 | 67.81 | 67.51 | 98.54 | 97.27 | 11.61 | 22.01 | 18.54 | 36.07 | 40.62 | 81.80 | 32.57 | 37.84 | 85.69 | 84.86 | 8.89 | 8.34 | 3.65 | 3.37 | 41.71 | 43.41 | 4.46 | 4.91 | 6.37 | 6.42 | 21.27 | 21.26 | 59.86 | 60.76 |
| 21 | 84.67 | 92.53 | 118.19 | 124.73 | 14.98 | 29.10 | 22.68 | 44.55 | 55.21 | 111.00 | 6.07 | 11.80 | 77.30 | 78.68 | 5.37 | 5.06 | 2.16 | 2.06 | 36.60 | 36.00 | 4.10 | 4.41 | 5.50 | 5.57 | 36.83 | 34.96 | 56.69 | 55.71 |
| 22 | 66.09 | 66.52 | 93.18 | 92.29 | 44.52 | 73.55 | 39.87 | 65.10 | 161.67 | 306.10 | 5.82 | 11.65 | 93.88 | 97.30 | 8.41 | 8.49 | 4.00 | 3.81 | 47.21 | 42.60 | 3.10 | 3.16 | 5.04 | 5.13 | 36.70 | 37.00 | 52.08 | 51.05 |
| 23 | 69.62 | 70.05 | 100.79 | 100.63 | 20.02 | 39.09 | 23.57 | 47.88 | 134.02 | 268.60 | 5.24 | 10.96 | 93.90 | 94.13 | 9.36 | 9.36 | 4.04 | 4.09 | 42.19 | 41.84 | 3.50 | 3.21 | 5.22 | 5.51 | 36.95 | 39.14 | 51.07 | 52.51 |
| 24 | 88.26 | 87.54 | 126.81 | 130.29 | 2.31 | 2.85 | 4.71 | 6.00 | 36.91 | 74.39 | 16.14 | 32.54 | 92.84 | 93.74 | 7.37 | 7.95 | 2.10 | 1.97 | 28.09 | 24.82 | 4.94 | 5.71 | 7.17 | 7.32 | 16.18 | 16.28 | 57.51 | 59.69 |
| 25 | 78.96 | 82.00 | 112.11 | 115.00 | 12.08 | 17.63 | 23.03 | 35.02 | 10.32 | 20.64 | 7.78 | 15.91 | 69.10 | 72.79 | 7.21 | 8.30 | 2.37 | 2.30 | 34.56 | 29.07 | 4.43 | 4.96 | 5.53 | 5.56 | 18.18 | 19.57 | 48.52 | 50.10 |
| 26 | 67.66 | 67.97 | 94.47 | 96.64 | 0.00 | -0.56 | -0.38 | -3.21 | 44.30 | 88.61 | 21.55 | 31.77 | 70.88 | 74.93 | 7.21 | 8.32 | 2.81 | 2.62 | 43.62 | 36.54 | 4.29 | 5.14 | 5.11 | 5.10 | 28.29 | 25.69 | 38.23 | 38.69 |
| 27 | 67.03 | 67.50 | 94.87 | 96.10 | 8.86 | 17.53 | 14.35 | 26.48 | 22.65 | 45.31 | 3.05 | 5.73 | 86.10 | 91.60 | 8.05 | 9.04 | 3.40 | 3.67 | 41.49 | 40.15 | 4.48 | 4.64 | 7.11 | 7.41 | 19.90 | 19.59 | 56.51 | 57.64 |
| 28 | 83.94 | 91.49 | 117.11 | 122.66 | 9.66 | 19.98 | 15.23 | 31.03 | 64.24 | 127.90 | 10.80 | 21.58 | 79.30 | 85.32 | 7.24 | 8.66 | 2.88 | 3.05 | 43.83 | 35.05 | 4.23 | 4.49 | 6.19 | 6.28 | 29.86 | 29.43 | 52.92 | 53.83 |
| 29 | 61.23 | 61.01 | 97.72 | 92.50 | 16.15 | 32.02 | 18.90 | 37.10 | 72.70 | 145.41 | 10.72 | 21.88 | 75.72 | 73.86 | 7.94 | 8.13 | 3.58 | 3.29 | 46.64 | 41.14 | 8.63 | 10.14 | 5.67 | 6.03 | 22.69 | 29.77 | 51.86 | 52.45 |
| 30 | 71.11 | 71.01 | 103.24 | 103.66 | 14.45 | 27.79 | 18.29 | 31.73 | 79.35 | 158.70 | 8.37 | 16.97 | 90.76 | 94.26 | 8.69 | 9.52 | 3.80 | 3.84 | 45.32 | 42.75 | 4.27 | 4.94 | 4.40 | 4.58 | 32.34 | 30.91 | 51.30 | 50.97 |
| 31 | 72.99 | 72.98 | 104.24 | 103.98 | 36.25 | 57.56 | 41.53 | 63.51 | 81.67 | 163.33 | 2.56 | 5.38 | 81.06 | 81.34 | 7.98 | 7.83 | 3.60 | 3.54 | 44.07 | 43.86 | 4.00 | 3.71 | 4.42 | 4.83 | 40.68 | 40.48 | 49.73 | 47.65 |
| 32 | 52.19 | 52.46 | 86.10 | 85.63 | 6.67 | 14.37 | 21.21 | 42.59 | 103.15 | 206.30 | 10.82 | 21.74 | 93.77 | 101.63 | 7.78 | 8.84 | 3.98 | 3.82 | 53.25 | 46.47 | 5.25 | 6.28 | 5.98 | 6.53 | 36.34 | 37.49 | 44.89 | 43.99 |
| 33 | 70.31 | 71.99 | 99.75 | 103.58 | 12.54 | 26.46 | 16.42 | 33.23 | 62.75 | 125.50 | 10.82 | 21.19 | 80.97 | 83.79 | 8.07 | 8.66 | 3.88 | 3.84 | 45.70 | 39.93 | 3.84 | 4.18 | 4.63 | 5.18 | 33.15 | 32.79 | 47.97 | 47.09 |
| 34 | 52.72 | 52.48 | 87.49 | 86.15 | 3.08 | 8.41 | 6.20 | 15.58 | 18.08 | 35.59 | 11.08 | 22.05 | 92.95 | 99.02 | 7.96 | 8.49 | 4.03 | 4.06 | 50.92 | 44.71 | 4.95 | 4.53 | 5.68 | 6.15 | 34.97 | 31.73 | 43.63 | 42.08 |
| 35 | 70.76 | 70.50 | 101.60 | 101.98 | 20.33 | 41.95 | 14.87 | 31.65 | 106.55 | 213.10 | 19.00 | 38.35 | 101.00 | 104.86 | 9.51 | 10.56 | 4.57 | 4.91 | 48.75 | 44.35 | 3.89 | 3.68 | 4.60 | 5.06 | 39.97 | 41.77 | 48.45 | 45.75 |
| 36 | 62.14 | 60.99 | 89.37 | 88.64 | 0.12 | 0.72 | 4.26 | 6.28 | 1.95 | 3.89 | 13.15 | 26.44 | 75.29 | 75.31 | 8.56 | 8.95 | 3.84 | 3.54 | 44.82 | 39.29 | 9.34 | 9.78 | 5.47 | 5.57 | 21.55 | 25.41 | 52.39 | 51.27 |
| Mean | 72.40 | 72.78 | 105.06 | 105.39 | 11.91 | 22.81 | 15.64 | 29.39 | 57.39 | 114.29 | 11.89 | 22.69 | 86.21 | 89.43 | 7.98 | 8.56 | 3.49 | 3.36 | 43.54 | 39.10 | 4.59 | 4.84 | 5.63 | 5.88 | 31.09 | 30.99 | 51.90 | 51.70 |
| LSD (5%) | 4.79 | 7.74 | 15.68 | 13.73 | 12.97 | 33.10 | 19.12 | 39.12 | 2.67 | 206.02 | 15.51 | 39.47 | 14.80 | 13.48 | 2.51 | 2.28 | 0.86 | 1.25 | 22.60 | 10.69 | 2.17 | 1.70 | 0.83 | 0.93 | 7.60 | 11.69 | 5.53 | 5.56 |
| CV% | 2.78 | 4.46 | 6.26 | 5.46 | 45.67 | 60.87 | 51.27 | 55.82 | 1.95 | 75.59 | 54.72 | 72.93 | 7.20 | 6.32 | 13.22 | 11.18 | 10.51 | 15.61 | 21.77 | 11.46 | 19.77 | 14.72 | 6.21 | 6.63 | 10.26 | 15.82 | 4.47 | 4.51 |

APPENDIX XXI: Mean of 14 traits across sprayed and non-sprayed plots from **Debre-Birhan** site 2012.

| | DH | | DM | | Scald | | SDI% | | AUDPC | | NB | | PH | | BY (tha$^{-1}$) | | GY (tha$^{-1}$) | | HI% | | TC | | SL | | SPS | | TSW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gen | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP |
| 1 | 79.87 | 78.42 | 135.50 | 130.65 | 46.02 | 60.01 | 43.34 | 100.23 | 222.14 | 396.04 | 61.99 | 43.81 | 112.38 | 110.54 | 11.84 | 12.02 | 8.17 | 7.76 | 68.50 | 63.18 | 9.57 | 9.39 | 6.56 | 7.51 | 58.48 | 53.30 | 42.90 | 38.98 |
| 2 | 80.50 | 78.00 | 128.63 | 134.09 | 38.83 | 84.36 | 19.71 | 99.11 | 177.37 | 316.24 | 2.22 | -2.06 | 105.76 | 113.66 | 9.09 | 9.36 | 6.04 | 5.76 | 72.23 | 60.85 | 8.34 | 9.24 | 7.48 | 7.34 | 60.16 | 64.39 | 40.31 | 38.48 |
| 3 | 83.50 | 83.50 | 132.00 | 130.37 | 50.69 | 81.37 | 58.49 | 99.18 | 120.25 | 275.66 | 73.65 | 84.88 | 112.33 | 112.68 | 11.85 | 11.50 | 6.82 | 6.53 | 58.09 | 56.78 | 16.16 | 11.85 | 8.99 | 7.62 | 30.93 | 29.11 | 48.44 | 42.69 |
| 4 | 78.86 | 78.73 | 139.80 | 131.59 | 41.52 | 86.68 | 84.26 | 99.13 | 132.67 | 324.79 | 1.96 | -10.93 | 116.69 | 117.84 | 7.53 | 8.01 | 5.57 | 5.10 | 75.26 | 63.50 | 6.80 | 8.63 | 6.19 | 6.61 | 57.21 | 61.58 | 45.55 | 37.37 |
| 5 | 78.76 | 79.96 | 127.97 | 130.53 | -2.03 | 84.89 | 20.91 | 98.83 | 20.80 | 211.37 | 2.39 | -14.29 | 97.19 | 98.98 | 7.46 | 10.14 | 6.33 | 6.04 | 82.23 | 60.09 | 10.69 | 11.93 | 6.57 | 7.97 | 44.42 | 47.69 | 37.55 | 33.78 |
| 6 | 84.71 | 89.73 | 141.00 | 139.08 | 0.03 | -4.35 | 1.72 | 50.80 | -1.06 | 384.25 | 55.27 | 68.62 | 103.36 | 109.06 | 8.44 | 15.33 | 6.15 | 7.39 | 75.60 | 48.49 | 12.54 | 8.92 | 9.04 | 8.50 | 70.79 | 63.57 | 40.87 | 38.91 |
| 7 | 82.84 | 80.65 | 133.80 | 124.67 | 1.51 | 23.76 | 2.07 | 63.16 | 2.70 | 136.57 | 65.81 | 94.78 | 110.99 | 104.00 | 8.09 | 9.91 | 4.74 | 5.22 | 56.28 | 51.88 | 12.94 | 12.15 | 8.73 | 8.45 | 26.72 | 24.88 | 45.75 | 44.73 |
| 8 | 80.98 | 80.23 | 137.43 | 128.60 | 40.82 | 70.84 | 36.88 | 99.25 | 85.09 | 409.91 | 70.54 | 46.41 | 112.07 | 121.81 | 9.34 | 10.88 | 7.14 | 6.28 | 78.45 | 31.47 | 9.16 | 7.95 | 7.49 | 6.66 | 70.05 | 68.13 | 42.56 | 36.73 |
| 9 | 78.47 | 78.73 | 133.30 | 129.89 | 37.18 | 84.36 | 38.78 | 99.31 | 117.62 | 353.39 | -2.03 | 9.85 | 96.01 | 97.69 | 8.06 | 11.18 | 5.99 | 6.09 | 73.28 | 54.59 | 12.79 | 6.41 | 8.00 | 7.96 | 55.56 | 62.50 | 39.38 | 31.88 |
| 10 | 79.34 | 78.46 | 136.10 | 130.61 | 64.01 | 73.17 | 84.25 | 99.27 | 160.54 | 390.97 | 28.78 | -3.46 | 106.65 | 98.19 | 7.66 | 8.29 | 6.11 | 4.81 | 77.17 | 57.11 | 10.03 | 9.34 | 7.73 | 7.85 | 68.35 | 55.21 | 40.06 | 30.49 |
| 11 | 78.74 | 77.69 | 135.27 | 128.04 | 24.96 | 78.37 | 33.94 | 98.97 | 54.52 | 425.47 | -1.30 | 34.18 | 102.65 | 107.34 | 10.71 | 10.86 | 7.50 | 6.61 | 66.81 | 61.78 | 12.32 | 9.39 | 6.96 | 7.09 | 54.90 | 56.32 | 42.95 | 38.16 |
| 12 | 81.69 | 84.96 | 139.80 | 140.60 | 1.53 | 57.63 | 20.22 | 95.95 | 22.96 | 378.29 | 51.58 | 70.59 | 110.37 | 122.22 | 9.09 | 14.10 | 4.86 | 6.50 | 53.79 | 46.21 | 11.92 | 14.28 | 8.01 | 8.34 | 25.48 | 25.71 | 47.92 | 47.67 |
| 13 | 79.37 | 84.77 | 137.97 | 133.18 | 1.02 | 79.75 | 3.14 | 82.34 | 33.35 | 311.20 | 49.09 | 89.69 | 109.13 | 107.74 | 10.38 | 11.21 | 7.79 | 6.43 | 72.22 | 57.66 | 10.16 | 12.98 | 7.67 | 7.31 | 52.71 | 48.22 | 42.20 | 38.53 |
| 14 | 86.50 | 84.85 | 139.60 | 131.11 | -1.17 | -1.16 | -16.14 | -0.31 | 0.44 | 177.31 | 24.82 | 91.82 | 116.61 | 125.95 | 11.15 | 11.74 | 6.57 | 6.80 | 62.52 | 58.39 | 8.83 | 9.98 | 8.03 | 7.79 | 51.94 | 49.52 | 45.62 | 37.26 |
| 15 | 83.00 | 81.35 | 133.47 | 127.40 | 0.70 | 4.35 | -5.68 | -0.25 | -3.03 | -16.32 | -1.25 | 94.76 | 94.58 | 98.18 | 10.71 | 9.88 | 7.72 | 6.05 | 72.51 | 62.31 | 16.85 | 11.24 | 7.92 | 7.04 | 44.65 | 41.34 | 36.62 | 32.78 |
| 16 | 82.87 | 84.08 | 140.77 | 129.12 | 1.02 | 86.16 | 4.82 | 93.76 | -3.01 | 252.24 | 65.56 | 68.94 | 118.74 | 125.98 | 12.00 | 12.63 | 7.79 | 6.41 | 64.92 | 51.29 | 12.49 | 13.02 | 7.82 | 7.48 | 56.79 | 53.10 | 38.87 | 30.07 |
| 17 | 79.26 | 80.81 | 132.93 | 130.05 | 30.48 | 89.87 | 11.32 | 99.41 | 62.37 | 174.57 | 29.98 | -5.41 | 107.69 | 115.13 | 8.25 | 11.44 | 8.14 | 7.33 | 94.30 | 65.62 | 10.49 | 10.27 | 6.98 | 7.47 | 53.70 | 57.01 | 40.63 | 36.74 |
| 18 | 79.71 | 79.58 | 127.97 | 127.10 | 47.04 | 86.63 | 34.72 | 98.93 | 96.01 | 262.57 | 62.36 | 81.50 | 111.56 | 110.86 | 7.71 | 8.84 | 5.27 | 5.11 | 69.10 | 58.71 | 7.54 | 9.36 | 6.23 | 6.17 | 57.17 | 55.90 | 39.78 | 34.11 |
| 19 | 85.79 | 81.81 | 141.20 | 131.19 | 1.85 | 79.48 | 12.14 | 80.66 | 20.72 | 254.50 | 63.75 | 83.91 | 100.49 | 106.27 | 9.59 | 11.93 | 7.40 | 6.86 | 77.04 | 57.65 | 12.03 | 12.00 | 7.83 | 7.25 | 51.26 | 53.01 | 39.11 | 33.21 |
| 20 | 80.92 | 80.38 | 126.33 | 136.13 | 36.16 | 91.56 | 25.28 | 100.25 | 222.85 | 348.00 | 2.98 | 22.04 | 105.47 | 105.63 | 9.69 | 12.02 | 5.44 | 6.10 | 60.40 | 51.16 | 11.50 | 16.40 | 7.87 | 8.36 | 25.99 | 27.61 | 47.04 | 45.33 |
| 21 | 83.42 | 90.88 | 139.70 | 138.41 | 22.03 | 90.08 | 5.08 | 100.32 | 33.63 | 216.79 | 74.91 | 77.47 | 106.14 | 110.45 | 9.33 | 11.24 | 6.79 | 6.48 | 74.49 | 58.80 | 11.68 | 11.20 | 6.98 | 6.74 | 52.60 | 56.08 | 44.84 | 38.12 |
| 22 | 80.79 | 77.61 | 136.50 | 129.63 | 54.35 | 95.38 | 37.89 | 100.27 | 106.95 | 176.83 | 2.72 | -12.34 | 109.95 | 106.56 | 7.41 | 6.27 | 5.74 | 3.83 | 79.51 | 61.63 | 7.52 | 7.84 | 7.01 | 6.72 | 56.34 | 53.64 | 45.26 | 30.89 |
| 23 | 78.69 | 79.35 | 132.17 | 129.07 | 46.31 | 86.59 | 35.03 | 79.09 | 160.18 | 195.10 | 59.14 | 56.31 | 102.50 | 104.90 | 8.94 | 12.56 | 7.82 | 7.67 | 86.88 | 62.38 | 10.06 | 9.34 | 6.49 | 6.54 | 51.85 | 54.10 | 43.55 | 39.67 |
| 24 | 77.13 | 89.11 | 133.20 | 135.62 | 1.87 | 77.85 | 6.14 | 87.99 | -1.83 | 442.82 | 25.52 | 71.72 | 112.47 | 125.98 | 12.32 | 13.68 | 6.56 | 4.24 | 56.16 | 33.07 | 10.76 | 13.78 | 9.59 | 9.64 | 27.62 | 27.34 | 46.82 | 41.27 |
| 25 | 85.19 | 83.65 | 131.97 | 125.68 | -0.03 | 7.84 | 4.21 | 7.81 | 3.44 | 290.52 | 62.47 | 98.95 | 89.60 | 91.39 | 7.87 | 7.77 | 3.62 | 3.29 | 45.26 | 43.27 | 10.28 | 11.73 | 7.79 | 6.74 | 27.70 | 24.64 | 41.47 | 37.59 |
| 26 | 78.32 | 77.73 | 125.10 | 125.61 | 18.28 | 86.92 | 4.42 | 100.19 | 45.27 | 173.97 | 58.20 | 84.08 | 90.93 | 96.20 | 9.48 | 10.15 | 7.78 | 6.11 | 86.81 | 60.97 | 11.30 | 9.59 | 7.45 | 7.89 | 42.38 | 45.69 | 33.24 | 28.57 |
| 27 | 81.81 | 80.73 | 138.47 | 131.90 | 51.14 | 89.93 | 30.11 | 98.77 | 137.25 | 152.43 | 1.13 | 12.01 | 107.61 | 107.82 | 8.64 | 11.61 | 5.35 | 5.52 | 62.21 | 48.21 | 18.48 | 12.84 | 9.61 | 8.92 | 26.64 | 26.81 | 46.88 | 42.60 |
| 28 | 81.18 | 85.46 | 135.27 | 134.62 | -0.03 | 87.24 | 15.58 | 100.21 | -0.63 | 168.25 | 72.94 | 77.20 | 97.72 | 106.38 | 7.65 | 10.24 | 5.58 | 6.11 | 73.53 | 60.32 | 12.62 | 11.97 | 7.80 | 6.78 | 43.78 | 46.97 | 41.52 | 38.09 |
| 29 | 78.08 | 79.69 | 129.43 | 125.55 | 39.42 | 89.45 | 46.83 | 99.55 | 167.15 | 349.67 | 1.87 | -4.65 | 86.47 | 93.82 | 7.62 | 9.41 | 5.35 | 5.94 | 67.11 | 65.02 | 18.01 | 14.82 | 7.60 | 7.45 | 23.14 | 26.03 | 48.69 | 45.72 |
| 30 | 77.53 | 79.46 | 129.97 | 130.60 | 46.48 | 78.71 | 40.76 | 87.81 | 94.74 | 221.95 | -1.25 | 0.76 | 113.74 | 109.25 | 11.20 | 11.36 | 8.68 | 7.67 | 79.22 | 68.35 | 12.46 | 8.32 | 7.17 | 6.97 | 54.26 | 54.47 | 39.32 | 36.71 |
| 31 | 82.45 | 79.88 | 135.17 | 129.74 | 0.18 | 74.82 | 3.62 | 97.46 | 1.20 | 305.65 | 82.37 | 95.70 | 99.13 | 105.02 | 9.64 | 10.30 | 7.10 | 7.37 | 73.95 | 68.71 | 11.16 | 9.73 | 5.94 | 5.88 | 56.73 | 58.94 | 36.26 | 34.69 |
| 32 | 80.58 | 78.96 | 126.80 | 124.67 | 54.99 | 67.91 | 45.23 | 97.33 | 192.49 | 347.91 | 0.09 | 39.83 | 100.61 | 97.53 | 8.41 | 9.08 | 6.40 | 5.53 | 82.50 | 59.56 | 11.19 | 11.33 | 7.86 | 8.66 | 45.56 | 50.48 | 36.87 | 33.47 |
| 33 | 78.08 | 80.46 | 130.17 | 129.46 | -0.15 | 84.92 | 9.30 | 93.97 | 29.02 | 242.38 | 30.03 | 50.27 | 102.88 | 107.31 | 8.97 | 12.30 | 6.47 | 7.02 | 73.93 | 56.34 | 9.86 | 8.79 | 6.94 | 7.39 | 43.22 | 56.26 | 40.70 | 37.82 |
| 34 | 77.94 | 79.19 | 131.97 | 130.18 | 46.68 | 83.73 | 53.32 | 99.94 | 111.29 | 286.73 | -0.17 | -4.55 | 97.09 | 94.81 | 8.21 | 9.33 | 6.71 | 5.91 | 84.04 | 60.99 | 11.25 | 14.07 | 7.07 | 7.18 | 43.51 | 51.22 | 35.17 | 32.36 |
| 35 | 79.34 | 78.42 | 137.13 | 129.61 | 77.13 | 83.94 | 58.25 | 99.64 | 249.32 | 168.68 | 0.26 | -7.90 | 110.84 | 121.86 | 8.86 | 12.34 | 6.91 | 6.44 | 76.40 | 53.35 | 6.59 | 10.22 | 6.17 | 5.90 | 61.32 | 66.38 | 46.01 | 41.05 |
| 36 | 77.79 | 78.69 | 125.67 | 126.67 | 36.19 | 83.20 | 65.28 | 100.58 | 130.01 | 207.63 | -2.86 | -2.49 | 84.93 | 89.64 | 7.84 | 10.33 | 5.10 | 6.36 | 69.20 | 60.42 | 17.24 | 15.67 | 7.30 | 7.90 | 22.94 | 24.67 | 47.43 | 44.40 |
| Mean | 80.61 | 81.28 | 133.88 | 130.58 | 26.58 | 72.28 | 27.09 | 86.36 | 83.47 | 269.84 | 32.65 | 43.94 | 104.54 | 107.74 | 9.20 | 10.81 | 6.49 | 6.03 | 71.72 | 56.67 | 11.49 | 11.00 | 7.52 | 7.45 | 47.13 | 47.83 | 42.17 | 37.53 |
| LSD (5%) | 6.69 | 3.70 | 7.22 | 8.57 | 36.08 | 21.06 | 44.14 | 37.85 | 157.76 | 300.72 | 36.70 | 58.73 | 10.83 | 11.75 | 3.21 | 3.34 | 1.49 | 1.51 | 18.10 | 21.67 | 6.64 | 4.88 | 1.38 | 1.32 | 14.09 | 9.88 | 5.15 | 4.84 |
| CV% | 3.48 | 1.91 | 2.26 | 2.75 | 56.91 | 12.22 | 68.34 | 18.38 | 79.27 | 46.73 | 47.13 | 56.04 | 4.35 | 4.57 | 14.65 | 12.96 | 9.61 | 10.36 | 10.58 | 16.04 | 24.24 | 18.60 | 7.67 | 7.45 | 12.54 | 8.66 | 5.12 | 5.41 |

APPENDIX XXII: Mean of 14 traits acros sprayed and non-sprayed plots from **Istayish** site 2012.

| | DH | | DM | | Scald | | SDI% | | AUDPC | | NB | | PH | | BY ($tha^{-1}$) | | GY ($tha^{-1}$) | | HI% | | TC | | SL | | SPS | | TSW | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Gen** | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP | SP | NSP |
| 1 | 101.64 | 98.37 | 154.96 | 148.66 | 10.72 | 25.68 | 12.46 | 16.89 | 198.68 | 142.61 | 0.48 | 36.29 | 71.95 | 80.27 | 8.81 | 9.40 | 3.56 | 3.18 | 40.34 | 34.83 | 4.27 | 8.00 | 5.16 | 6.25 | 36.72 | 41.99 | 35.65 | 36.86 |
| 2 | 98.33 | 103.75 | 146.18 | 164.57 | 10.51 | 14.63 | 12.18 | 17.64 | 100.34 | 81.37 | 1.18 | 24.09 | 79.68 | 62.16 | 7.63 | 6.64 | 3.55 | 1.60 | 44.45 | 24.39 | 4.52 | 6.21 | 6.48 | 5.80 | 35.59 | 30.78 | 34.54 | 33.47 |
| 3 | 101.15 | 99.40 | 152.01 | 150.23 | 6.46 | 7.64 | 11.59 | 27.57 | 113.82 | 88.92 | 0.94 | 56.89 | 79.59 | 72.43 | 6.81 | 10.89 | 3.46 | 4.11 | 50.78 | 36.67 | 10.61 | 9.65 | 7.36 | 7.62 | 25.97 | 43.49 | 30.69 | 33.76 |
| 4 | 101.90 | 97.33 | 149.21 | 146.46 | 5.72 | 33.18 | 7.05 | 37.79 | 54.20 | 156.98 | 0.74 | 0.82 | 81.32 | 83.55 | 6.36 | 8.38 | 2.74 | 2.32 | 39.90 | 27.08 | 5.58 | 6.33 | 4.96 | 4.24 | 45.12 | 37.58 | 32.85 | 38.36 |
| 5 | 96.77 | 98.48 | 147.92 | 143.49 | -0.22 | 2.68 | -0.56 | 1.26 | 102.69 | -2.35 | 30.56 | 72.43 | 75.43 | 82.27 | 6.71 | 9.69 | 2.87 | 3.84 | 46.52 | 36.50 | 5.91 | 6.96 | 5.89 | 6.98 | 34.35 | 38.01 | 36.55 | 34.92 |
| 6 | 103.15 | 114.60 | 155.58 | 158.08 | 6.95 | -2.48 | 14.18 | 2.95 | 151.35 | 2.41 | 11.38 | 2.20 | 62.10 | 62.82 | 9.76 | 9.98 | 3.53 | 2.95 | 36.92 | 30.98 | 7.30 | 4.64 | 6.50 | 5.63 | 27.39 | 33.21 | 35.70 | 34.02 |
| 7 | 98.09 | 99.95 | 150.26 | 150.21 | 5.01 | 18.07 | 0.39 | 24.19 | 95.18 | 32.00 | 52.20 | 82.28 | 79.81 | 92.01 | 8.58 | 10.59 | 3.32 | 2.76 | 40.90 | 27.08 | 7.32 | 10.02 | 8.72 | 8.89 | 29.42 | 25.19 | 32.45 | 40.56 |
| 8 | 105.78 | 105.83 | 151.98 | 159.62 | 4.29 | 35.51 | 8.95 | 40.11 | 81.84 | 63.26 | 1.89 | 30.57 | 77.94 | 77.30 | 7.40 | 11.23 | 3.18 | 3.98 | 46.69 | 35.36 | 6.96 | 7.73 | 6.74 | 5.54 | 33.19 | 42.48 | 33.34 | 34.66 |
| 9 | 94.61 | 95.98 | 146.81 | 145.78 | 0.25 | 60.02 | 0.67 | 52.69 | 100.32 | 95.81 | 27.65 | 39.37 | 71.95 | 84.47 | 7.58 | 10.08 | 2.61 | 3.38 | 36.69 | 32.74 | 7.45 | 6.77 | 6.42 | 7.06 | 23.07 | 39.39 | 38.99 | 39.95 |
| 10 | 101.85 | 95.42 | 152.01 | 146.51 | -0.49 | 64.06 | -1.52 | 56.53 | 35.70 | 37.37 | 16.95 | 64.80 | 69.08 | 89.49 | 6.03 | 10.17 | 2.74 | 4.47 | 47.97 | 43.05 | 7.03 | 10.15 | 6.22 | 6.38 | 23.22 | 55.57 | 33.15 | 36.55 |
| 11 | 105.22 | 103.56 | 159.72 | 156.05 | -0.94 | 72.06 | -1.88 | 42.71 | 34.19 | 173.54 | 0.27 | 31.92 | 75.89 | 79.92 | 10.28 | 9.08 | 4.14 | 2.98 | 44.11 | 28.32 | 4.65 | 4.78 | 6.65 | 7.12 | 40.35 | 45.11 | 34.35 | 33.11 |
| 12 | 104.61 | 102.68 | 154.37 | 159.63 | 0.74 | 49.40 | 4.41 | 22.52 | 47.86 | 161.80 | 1.60 | 39.69 | 84.66 | 82.37 | 8.73 | 9.37 | 3.38 | 2.89 | 44.49 | 32.87 | 9.95 | 7.56 | 7.56 | 7.77 | 29.69 | 28.81 | 37.50 | 41.21 |
| 13 | 119.10 | 112.92 | 155.34 | 156.84 | 9.54 | 9.75 | 2.63 | 1.84 | 177.74 | -3.94 | -0.26 | -7.27 | 81.15 | 59.13 | 6.66 | 8.95 | 2.26 | 1.73 | 32.48 | 20.64 | 5.70 | 5.97 | 6.96 | 5.93 | 31.84 | 14.30 | 36.96 | 36.07 |
| 14 | 109.79 | 108.29 | 158.06 | 161.26 | -1.68 | 15.70 | -3.80 | 1.27 | 110.91 | 8.83 | 0.44 | -3.48 | 84.08 | 75.32 | 9.68 | 11.00 | 3.47 | 3.57 | 34.88 | 33.09 | 6.15 | 9.58 | 6.08 | 5.77 | 28.21 | 33.28 | 34.84 | 35.68 |
| 15 | 116.62 | 102.94 | 166.40 | 149.41 | -0.22 | 19.20 | 0.17 | 21.76 | 91.89 | -5.13 | 0.20 | 32.82 | 71.69 | 70.19 | 8.06 | 10.05 | 4.44 | 3.35 | 59.71 | 32.03 | 6.94 | 7.92 | 7.97 | 6.19 | 33.79 | 24.29 | 35.00 | 39.46 |
| 16 | 110.86 | 101.88 | 158.59 | 159.15 | -0.96 | 29.74 | -2.03 | 38.47 | 102.26 | 46.43 | 15.50 | 42.75 | 80.92 | 71.81 | 7.51 | 8.14 | 4.02 | 2.14 | 50.75 | 26.28 | 7.21 | 6.50 | 6.26 | 7.01 | 47.44 | 16.68 | 31.16 | 33.56 |
| 17 | 102.23 | 98.02 | 152.81 | 147.18 | -1.41 | 30.75 | -2.38 | 13.27 | -1.74 | 18.60 | -1.18 | 18.87 | 74.63 | 65.74 | 9.36 | 9.65 | 3.45 | 3.90 | 39.23 | 39.04 | 5.64 | 8.33 | 7.10 | 5.45 | 48.77 | 35.61 | 38.36 | 33.13 |
| 18 | 101.12 | 98.64 | 150.96 | 146.26 | 11.27 | 58.08 | 6.95 | 62.69 | 179.42 | 40.86 | 0.14 | 16.14 | 80.60 | 85.48 | 6.21 | 9.74 | 2.61 | 3.36 | 44.82 | 35.71 | 4.93 | 5.32 | 6.01 | 5.70 | 37.01 | 35.82 | 34.50 | 36.23 |
| 19 | 114.60 | 110.22 | 158.73 | 156.88 | 5.97 | 43.82 | 10.64 | 45.50 | 101.78 | 29.12 | -0.14 | 24.80 | 77.23 | 84.39 | 7.77 | 10.22 | 4.31 | 3.70 | 56.74 | 37.50 | 6.71 | 11.38 | 6.26 | 7.05 | 25.81 | 44.92 | 30.26 | 37.63 |
| 20 | 97.79 | 99.10 | 146.45 | 149.80 | 10.25 | 72.27 | 26.21 | 62.32 | 63.95 | 122.89 | 0.56 | 18.09 | 84.16 | 79.78 | 9.59 | 9.86 | 3.75 | 3.64 | 40.26 | 36.45 | 8.55 | 8.69 | 7.88 | 8.10 | 32.48 | 29.51 | 39.14 | 41.74 |
| 21 | 101.62 | 117.25 | 153.79 | 159.95 | 1.21 | 3.78 | 8.72 | 10.10 | 27.43 | 72.93 | 47.81 | 20.89 | 89.97 | 76.05 | 8.57 | 8.91 | 3.54 | 2.46 | 42.27 | 25.09 | 5.65 | 4.63 | 5.46 | 6.12 | 39.16 | 40.02 | 37.30 | 37.02 |
| 22 | 102.86 | 96.68 | 152.98 | 149.19 | 5.97 | 61.82 | 10.28 | 46.91 | 106.81 | 147.50 | 0.11 | -0.18 | 84.41 | 74.07 | 8.52 | 8.60 | 3.64 | 3.69 | 47.60 | 42.37 | 5.62 | 8.11 | 7.36 | 14.64 | 29.41 | 34.51 | 37.45 | 40.12 |
| 23 | 98.73 | 99.33 | 151.20 | 149.22 | 11.02 | 63.82 | 14.67 | 35.82 | 61.30 | 86.67 | 24.93 | 66.44 | 81.02 | 79.99 | 7.67 | 10.71 | 4.32 | 4.21 | 62.63 | 35.76 | 5.95 | 5.54 | 5.59 | 6.68 | 41.04 | 47.94 | 35.16 | 33.69 |
| 24 | 107.12 | 99.44 | 153.85 | 148.31 | 1.70 | 53.16 | 8.31 | 37.99 | 92.46 | 17.92 | 0.26 | 37.71 | 87.28 | 84.94 | 8.72 | 10.60 | 3.62 | 3.41 | 44.60 | 32.55 | 9.74 | 10.62 | 8.60 | 8.13 | 21.78 | 29.24 | 38.30 | 39.29 |
| 25 | 105.98 | 101.61 | 150.06 | 149.16 | 5.48 | 20.27 | 7.93 | 37.71 | 32.63 | 52.81 | 30.49 | 62.02 | 63.42 | 67.56 | 8.12 | 9.60 | 2.34 | 2.72 | 25.55 | 28.90 | 8.67 | 7.41 | 6.53 | 6.42 | 22.40 | 37.42 | 35.20 | 35.76 |
| 26 | 94.67 | 97.98 | 140.28 | 142.58 | -0.74 | 26.22 | 1.80 | 31.63 | 51.30 | 62.58 | -0.31 | 48.32 | 76.35 | 78.05 | 7.54 | 8.65 | 3.45 | 2.86 | 43.34 | 31.85 | 6.22 | 9.72 | 5.85 | 7.87 | 39.37 | 33.30 | 33.59 | 37.36 |
| 27 | 105.00 | 99.63 | 150.11 | 150.73 | 0.72 | 2.22 | 6.17 | 11.46 | 63.28 | 5.12 | 9.94 | 14.62 | 77.97 | 76.92 | 8.52 | 10.09 | 2.96 | 3.47 | 32.39 | 32.00 | 7.51 | 9.36 | 5.63 | 7.69 | 30.45 | 42.41 | 33.74 | 39.15 |
| 28 | 102.24 | 106.07 | 152.31 | 135.97 | -0.02 | 17.76 | 1.57 | 33.97 | 31.15 | 139.18 | -0.75 | 4.05 | 74.40 | 75.14 | 11.57 | 10.58 | 4.55 | 4.51 | 35.79 | 41.31 | 8.18 | 12.44 | 5.83 | 5.91 | 50.21 | 47.10 | 36.40 | 37.25 |
| 29 | 99.62 | 95.21 | 152.52 | 140.50 | 10.03 | 57.77 | 10.67 | 47.26 | 179.65 | 108.86 | -1.94 | 2.16 | 64.01 | 67.87 | 8.82 | 9.69 | 3.21 | 3.42 | 35.51 | 31.85 | 8.81 | 7.87 | 5.56 | 5.95 | 24.64 | 35.23 | 35.60 | 35.81 |
| 30 | 97.50 | 98.33 | 143.68 | 150.58 | 6.71 | 19.60 | 13.00 | 15.30 | 48.31 | 161.11 | -0.61 | 20.93 | 85.57 | 78.32 | 7.87 | 10.59 | 4.68 | 3.81 | 57.65 | 35.69 | 6.50 | 6.96 | 5.27 | 7.60 | 34.88 | 38.14 | 36.25 | 37.91 |
| 31 | 110.48 | 110.24 | 147.05 | 145.20 | 5.48 | 13.68 | 5.45 | 27.95 | 122.47 | 59.11 | -1.15 | 48.92 | 78.76 | 71.65 | 8.14 | 10.25 | 4.17 | 3.29 | 51.07 | 35.22 | 5.27 | 5.63 | 5.78 | 5.36 | 51.18 | 42.08 | 38.91 | 34.41 |
| 32 | 99.67 | 103.11 | 143.77 | 150.62 | -0.74 | 35.63 | -2.38 | 43.82 | 102.13 | 57.38 | -0.46 | 10.71 | 84.59 | 76.04 | 7.16 | 9.69 | 3.71 | 3.14 | 52.23 | 34.82 | 7.42 | 11.93 | 7.80 | 7.60 | 17.85 | 35.36 | 35.30 | 30.52 |
| 33 | 97.00 | 96.76 | 145.10 | 142.77 | 0.72 | 28.64 | 1.59 | 29.50 | 133.11 | -0.08 | 61.80 | 68.51 | 81.40 | 81.91 | 9.54 | 9.54 | 4.35 | 3.18 | 46.89 | 32.33 | 8.41 | 7.97 | 6.88 | 5.32 | 42.03 | 31.37 | 43.45 | 36.81 |
| 34 | 97.24 | 95.20 | 145.30 | 141.50 | -0.02 | 32.68 | -0.61 | 23.16 | 128.49 | 74.48 | 14.60 | 24.44 | 83.13 | 72.13 | 7.59 | 9.43 | 2.46 | 1.94 | 29.27 | 22.41 | 8.28 | 12.76 | 6.68 | 5.84 | 42.88 | 31.46 | 32.61 | 36.91 |
| 35 | 100.12 | 100.84 | 156.01 | 147.54 | 10.03 | 78.68 | 7.69 | 62.51 | 99.48 | 141.15 | -2.08 | 1.56 | 80.94 | 79.45 | 7.84 | 8.54 | 3.63 | 2.57 | 47.86 | 30.31 | 5.01 | 5.09 | 6.81 | 5.98 | 23.31 | 46.29 | 32.81 | 32.97 |
| 36 | 95.50 | 96.96 | 143.66 | 147.12 | 6.71 | 45.51 | 9.17 | 34.74 | 163.14 | 58.41 | -0.75 | 19.83 | 76.01 | 75.60 | 7.29 | 11.63 | 3.75 | 3.51 | 52.57 | 33.06 | 9.10 | 9.97 | 7.32 | 7.73 | 21.45 | 25.10 | 40.96 | 41.57 |
| Mean | 102.54 | 102.00 | 151.39 | 150.19 | 4.06 | 33.92 | 5.84 | 31.10 | 94.04 | 70.46 | 9.53 | 29.86 | 78.14 | 76.57 | 8.14 | 9.73 | 3.49 | 3.22 | 44.05 | 32.67 | 6.94 | 8.01 | 6.56 | 6.81 | 33.37 | 35.92 | 35.53 | 36.60 |
| LSD (5%) | 13.95 | 18.79 | 10.66 | 18.15 | 16.64 | 62.18 | 22.33 | 55.30 | 162.26 | 192.40 | 33.00 | 56.34 | 17.69 | 20.79 | 4.36 | 4.06 | 2.00 | 2.65 | 31.73 | 20.62 | 6.49 | 5.83 | 2.53 | 4.61 | 22.29 | 34.82 | 10.17 | 11.68 |
| CV% | 5.70 | 7.73 | 2.95 | 5.07 | 172.02 | 76.88 | 160.26 | 74.56 | 72.36 | 114.51 | 145.24 | 79.13 | 9.49 | 11.39 | 22.45 | 17.50 | 24.00 | 34.54 | 30.21 | 26.47 | 39.22 | 30.51 | 16.15 | 28.38 | 28.01 | 14.32 | 12.01 | 13.38 |

APPENDIX XXIII: Combined mean of the sprayed and non-sprayed blocks ***across three locations*** for 14 traits

| Gen | DH | DM | Scald | SDI | AUDPC | NB | PH | BY | GY | HI% | TC | SL | SPS | TSW |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 83.21 | 129.05 | 35.96 | 37.18 | 166.97 | 28.79 | 93.47 | 10.03 | 5.40 | 53.61 | 6.47 | 6.01 | 42.68 | 42.82 |
| 2 | 85.33 | 128.82 | 32.67 | 34.50 | 146.63 | 5.33 | 89.79 | 8.61 | 4.05 | 48.61 | 6.25 | 6.16 | 44.71 | 41.91 |
| 3 | 93.46 | 134.75 | 31.33 | 41.46 | 131.98 | 37.64 | 89.56 | 9.77 | 4.77 | 48.46 | 10.27 | 7.68 | 28.34 | 45.33 |
| 4 | 83.15 | 128.39 | 39.48 | 51.17 | 164.05 | 4.22 | 99.36 | 7.65 | 3.79 | 49.68 | 5.75 | 5.37 | 49.03 | 42.20 |
| 5 | 79.99 | 124.21 | 18.12 | 25.06 | 68.87 | 17.74 | 88.60 | 8.42 | 4.57 | 54.15 | 8.28 | 6.35 | 38.31 | 39.14 |
| 6 | 91.69 | 138.85 | 1.13 | 12.49 | 94.38 | 24.01 | 80.41 | 9.81 | 4.21 | 43.96 | 7.23 | 7.21 | 43.35 | 45.92 |
| 7 | 85.37 | 129.46 | 9.28 | 16.60 | 48.03 | 56.23 | 91.08 | 8.37 | 3.51 | 43.05 | 8.57 | 7.82 | 23.49 | 46.00 |
| 8 | 86.57 | 131.32 | 28.99 | 38.59 | 120.50 | 29.11 | 93.85 | 9.15 | 4.64 | 48.50 | 6.53 | 5.95 | 49.05 | 41.03 |
| 9 | 75.70 | 121.74 | 33.06 | 34.78 | 119.81 | 15.58 | 89.23 | 8.70 | 4.51 | 51.62 | 6.99 | 6.81 | 41.80 | 42.03 |
| 10 | 76.56 | 125.38 | 37.38 | 42.65 | 113.95 | 26.74 | 92.96 | 7.86 | 4.39 | 55.60 | 7.10 | 6.71 | 46.86 | 39.75 |
| 11 | 84.24 | 129.87 | 35.78 | 37.33 | 140.73 | 14.85 | 90.74 | 9.56 | 4.86 | 49.24 | 6.15 | 6.44 | 45.30 | 42.30 |
| 12 | 87.84 | 136.34 | 19.45 | 24.85 | 106.86 | 29.70 | 94.76 | 9.40 | 3.83 | 42.13 | 8.80 | 7.31 | 23.60 | 47.82 |
| 13 | 96.20 | 139.76 | 17.06 | 18.09 | 94.36 | 27.95 | 82.68 | 8.21 | 3.69 | 41.62 | 7.43 | 6.64 | 36.11 | 43.19 |
| 14 | 94.81 | 140.28 | 3.94 | 1.82 | 66.49 | 24.07 | 97.35 | 9.72 | 4.26 | 44.65 | 7.13 | 7.08 | 36.50 | 46.30 |
| 15 | 87.86 | 130.54 | 4.18 | 3.67 | 17.11 | 22.29 | 80.75 | 9.10 | 4.66 | 50.61 | 8.95 | 6.87 | 32.76 | 41.37 |
| 16 | 93.89 | 140.43 | 23.16 | 26.45 | 83.85 | 35.46 | 93.89 | 9.17 | 4.14 | 42.15 | 7.76 | 6.75 | 40.86 | 38.69 |
| 17 | 83.23 | 126.92 | 28.05 | 24.54 | 61.51 | 10.06 | 90.24 | 9.31 | 5.10 | 53.92 | 7.38 | 6.09 | 44.70 | 41.06 |
| 18 | 83.50 | 126.56 | 39.39 | 39.46 | 127.53 | 32.99 | 96.70 | 8.73 | 4.06 | 48.31 | 6.12 | 5.52 | 43.95 | 42.77 |
| 19 | 92.45 | 137.02 | 24.28 | 30.99 | 91.29 | 34.22 | 89.93 | 9.08 | 4.70 | 50.72 | 8.53 | 6.60 | 41.37 | 39.94 |
| 20 | 82.31 | 126.13 | 37.49 | 43.00 | 147.99 | 16.51 | 91.99 | 9.92 | 4.37 | 45.41 | 9.03 | 7.39 | 25.86 | 48.94 |
| 21 | 93.78 | 138.14 | 22.73 | 27.78 | 84.14 | 37.73 | 89.86 | 8.16 | 3.92 | 45.44 | 7.10 | 6.06 | 43.26 | 45.03 |
| 22 | 81.80 | 125.78 | 50.13 | 44.81 | 152.01 | 1.40 | 94.94 | 7.97 | 4.14 | 53.89 | 5.85 | 7.69 | 41.27 | 42.77 |
| 23 | 82.56 | 127.18 | 39.94 | 34.61 | 120.38 | 37.01 | 93.22 | 9.70 | 5.33 | 55.14 | 6.42 | 5.92 | 44.53 | 42.33 |
| 24 | 91.59 | 137.49 | 20.61 | 22.19 | 94.83 | 28.94 | 99.97 | 10.05 | 3.67 | 37.16 | 9.18 | 8.30 | 23.11 | 46.70 |
| 25 | 89.01 | 130.20 | 8.81 | 15.71 | 75.75 | 45.59 | 76.25 | 7.95 | 2.79 | 35.10 | 7.60 | 6.41 | 24.26 | 41.13 |
| 26 | 80.62 | 120.56 | 22.19 | 23.90 | 58.22 | 36.80 | 81.88 | 8.48 | 4.31 | 51.66 | 7.35 | 6.55 | 34.96 | 35.18 |
| 27 | 83.51 | 126.90 | 27.01 | 28.59 | 76.35 | 5.68 | 91.15 | 9.20 | 4.02 | 42.59 | 9.49 | 7.79 | 26.59 | 46.01 |
| 28 | 90.53 | 132.03 | 21.58 | 29.13 | 70.07 | 29.77 | 86.93 | 9.13 | 4.43 | 49.23 | 8.68 | 6.61 | 40.58 | 43.17 |
| 29 | 79.12 | 123.85 | 38.64 | 39.54 | 164.02 | 3.46 | 78.19 | 8.52 | 4.18 | 48.42 | 10.99 | 6.38 | 24.69 | 45.08 |
| 30 | 82.48 | 126.91 | 29.32 | 29.33 | 111.62 | 6.64 | 95.72 | 9.79 | 5.42 | 55.16 | 6.93 | 5.99 | 40.36 | 42.25 |
| 31 | 86.71 | 127.66 | 26.60 | 35.23 | 126.61 | 39.74 | 85.74 | 8.97 | 4.84 | 53.37 | 6.59 | 5.17 | 49.13 | 40.35 |
| 32 | 77.82 | 119.85 | 28.56 | 39.31 | 132.88 | 10.45 | 90.79 | 8.35 | 4.45 | 56.66 | 8.70 | 7.20 | 36.97 | 37.74 |
| 33 | 82.21 | 124.61 | 22.88 | 27.81 | 91.77 | 37.67 | 88.38 | 9.38 | 4.79 | 50.54 | 7.27 | 5.96 | 40.01 | 42.34 |
| 34 | 75.98 | 120.66 | 28.70 | 30.76 | 107.43 | 10.58 | 88.81 | 8.39 | 4.17 | 49.99 | 9.29 | 6.40 | 40.37 | 37.15 |
| 35 | 83.41 | 128.90 | 48.51 | 42.72 | 148.30 | 5.86 | 98.51 | 9.31 | 4.77 | 51.29 | 5.83 | 5.62 | 46.40 | 41.56 |
| 36 | 78.93 | 120.38 | 27.52 | 34.03 | 96.91 | 7.79 | 78.85 | 9.02 | 4.40 | 51.48 | 11.76 | 6.76 | 23.40 | 46.41 |
| Mean | *85.21* | *129.36* | *26.78* | *30.28* | *106.23* | *23.29* | *89.90* | *8.97* | *4.36* | *48.70* | *7.77* | *6.60* | *37.74* | *42.60* |
| LSD (5%) | *10.37* | *12.37* | *31.62* | *35.91* | *193.02* | *38.86* | *14.26* | *3.24* | *1.60* | *20.55* | *4.80* | *2.261* | *17.38* | *7.28* |
| CV% | *5.47* | *4.22* | *52.17* | *52.37* | *80.25* | *73.68* | *7.00* | *15.93* | *16.16* | *18.63* | *27.29* | *15.13* | *20.34* | *7.54* |