Assessment of Correlation coefficient in 20 genotypes of Gladiolus (Gladiolus grandiflorus L.) for Gwalior region.

Abstract

Analysis of correlation coefficient in twenty genotypes of gladiolus (Gladiolus grandiflorus L.) were studied at department of Genetics and plant breeding, school of agriculture, ITM University, Gwalior, Madhya It was observed that the magnitude of genotypic correlation coefficient was invariably higher than their phenotypic correlation coefficients, suggesting therefore, a strong inherent relationship in different traits.

The characterno. of corms per plant exhibited a significant and positive correlation at both genotypic and phenotypic level for the character shoots per corm. Length of spike was positively and significant correlated with rachis length, no. of florets per spikes, senescence of last floret, plant height at spike fully opened, days to senescence of 1^{st} floret, diameter of 3^{rd} floret and days to last floret opening.

Rachis length is one of the important characters for the export purpose, which showed positively and significantly associated with no. of florets per spike, senescence of last floret, plant height at spike fully opened, days to senescence of 1^{st} flower, diameter of 1^{st} floret, diameter of 3^{rd} floret and days to last floret opening and negatively correlated at both genotypic and phenotypic level with trait durability of spike which indicates that more length of rachis will lead to more number of florets, plant height, more days to senescence of florets. Small rachis length directly affects the durability of spikes, which indicate that taller varieties showed be selected for export purpose.

KEY WORDS: Gladiolus, Correlation

Introduction

Gladiolus is a bulbous ornamental flower having beautiful spikes as well as larger vase life, it belongs to family Iridaceae and sub- family Ixodidae, popularly known as “Queen of bulbous flower”. The centre of origin of Gladiolus is South Africa and widely spread in central Europe, Mediterranean region, western Asia and Asia Minor. This genus is mostly heteroploidy having, Ploidy in the genus ranges from diploid (2n= 30) to decaploid (2n = 12X = 180).Gladiolus occupies 8^{th} position in international cut flower trade after Rose, Carnation and Chrysanthemum (Ahmad *et. al.,* 2008). Worldwide it is being grown in an area of 11,660 ha in the country with an estimated production of 106 crore cut flowers (Verty*et.al.,* 2017). In India, major gladiolus producing states in country are Uttar Pardesh, West Bengal, Odisha, Chattisgarh, Haryana and Maharastra, as it is mainly a winter season flower crop, in areas having moderate climate conditions, gladiolus can be grown throughout the year. There are many varieties of gladiolus having beautiful inflorescence in large range of colours, different shades, size and wide range of No. of florets per spike.Genetic variation and Genetic relationship among genotypes are an important consideration for classification and utilization of

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germplasm resources in breeding programmes (Kumar *et. al.,* 2013). The and magnitude of genetic variability in gene pool is the prerequisite of the breeding programme (Bhujbal *et. al.,* 2013).

The main objective of a plant of a breeder is to evolve high yielding varieties of Gladiolus suitable for cut flower purpose, it is therefore desirable for plant breeder to know the extent of relationship between yield and its various components which will facilitate selection based on component traits (Prasad *et al.,* 2011).

Thus, yield and association of yield contributing traits is considered to be of great importance for planning and executing breeding programme. Correlation study provide beneficial information regarding the inter relationship of yield traits there by aide in selection.

Materials and Method

The present investigation was carried out at CRC (Crop Research Centre), Department of Genetics and Plant Breeding, School of Agriculture, ITM University, Gwalior, Madhya Pardesh, India.The experiment was conducted during 2021-2022 in Randomized block design (RBD) with three replications. The experimental material for the research consisted of 20 genotypes of gladiolus. 15 corms of each genotype were planted with the spacing of 30 ×15 cm. All the recommended agronomic practices and management were followed to grow a successful crop. The observations were recorded on five randomly selected plants for twenty-four characters.The correlation coefficient is calculated by first determining the covariance of the variables and then dividing that quantity by the product of those variables standard deviations.Correlation measures the degree and direction of association between two or more variables and mutual relationship between various plant characters and determines the component character on which selection is based for genetic improvement for a particular character.

As correlation provides information about yield contributing characters. This information is useful to plant breeders in selection of elite genotypes from diverse genetic populations (Robinson *et al.*, 1951; Jhonson*et al.*, 1955). Mass selection has been used to improve grain yield in several crops through indirect selection for highly traits which are associated with yield (Simmonds, 1979).

Data Collection

Data Analysis

Treatments

Results and Discussion

Shoots per corm, no. of florets per spike, spike length, no. of spike per plant, no. of corms produced per mother corm are important economic character in gladiolus.

Estimates of correlation coefficient among yield contributing character in a population of 20 genotypes of Gladiolus at genotypic and phenotypic levels are presented in (Table 1 and 2).

Present investigation revealed that in general phenotypic coefficient of correlation were having higher values for most of the characters than that of genotypic correlation coefficient. Similar observations were reported by various workers including Verty*et al.,* (2017), Lal *et al.,* (1985), Gowda (1989) and Misra and Saini (1990).

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50% Sprouting

The character days to50% sprouting displayed a positive correlation at both genotypic and phenotypic level for the characters plant height at flowering stage **(**r_g 0.32;r_p 0.31), diameter of 1st floret (r_g 0.56; r_p 0.32), and diameter of 3rd floret (r_g 0.39; r_p 0.26). In case of negative correlation only two characters were found to have negative association with days to 50% sprouting, the characters are corms per plant (-0.27) and no. of shoots per corm (-0.33). The phenotypic correlation matrix does not display significant negative correlation for any of the studied trait.

Days to 50% sprouting was positively and significantly correlated with plant height at flowering stage, diameter of 1st floret and diameter of 3rd floret at both genotypic and phenotypic level. Similar observation was reported by verty*et al.,* (2017), Choudhary *et al.,* (2011) and Ahmad *et al.,* (2012).

Spike Initiation

The character days to spike initiation displayed a positive correlation at both genotypic and phenotypic level for the characters 50% heading (r_g 0.58; r_p 0.44), days to 1st floret initiation (r_g 0.54; r_p 0.43), spike length (r_g 0.43; r_p 0.26), rachis length (r_g 0.54; r_p 0.28), senescence of last floret (r_g 0.50; r_p 0.40), plant height at fully spike opened (r_g 0.56; r_p 0.34), diameter of 1st flower (r_g 0.47; r_p 0.28), days to last floret opening (r_g 0.56; r_p 0.45). Only one character has been recorded to have negative correlation that is durability of spike (r_g - 0.45; r_p - 0.31).

Days to spike initiation showed significant and positive correlation with 50% heading, days to 1st floret initiation, spike length, rachis length, days to senescence of last floret, plant height at spike fully opened, diameter of 1st floret and days to last floret opening at both genotypic and phenotypic level, Anuradha *et al.,* (2002), Archana *et al.,* (2002) and Bhujbal *et al.,* (2013) had also reported coinciding trends for days to spike initiation.

Plant Height at Flowering Stage

The character days to Plant height at flowering stage displayed a significant and positive correlation at both genotypic and phenotypic level for the characters 50% heading (r_g 0.61;r_p 0.54), days to 1st floret initiation (r_g 0.67;r_p 0.59), spike length (r_g 0.68;r_p 0.49), rachis length (r_g 0.68;r_p 0.44), no. of floret spike (r_g 0.44;r_p 0.32), senescence of last floret (r_g 0.71;r_p 0.59), plant height at spike fully opened (r_g 0.57;r_p 0.38), days to senescence of 1st flower (r_g 0.65;r_p 0.57), diameter of 1st flower (r_g 0.87;r_p 0.52), diameter of 3rd floret (r_g 0.93;r_p 0.47), days to last floret opening (r_g 0.67;r_p 0.57) and significantly negative correlation had been recorded in weight of daughter corms (r_g - 0.40;r_p -0.29) in association with character plant height. In contrast to thistrait *viz.,* diameter of daughter corms displayed significantly negative genotypic correlation.

Plant height at flowering stage recorded significant and positive correlation with 50% heading, days to 1st floret initiation, spike length, rachis length, no. of florets per spike, senescence of last floret, plant height at spike fully opened, days to senescence of 1st flower, diameter of 1st flower, diameter of 3rd floret, days to last floret opening. This association of plant height with traits mentioned is a desirable feature in this crop. These results are in agreement with earlier reports of Neeraj *et al.*, (2001), Jhon *et al.*, (2002), Misra and Saini (1990), Gowda (1989), Lal *et al.*, (1985) in gladiolus and Kavitha and Anburani (2010) in African marigold and Rakesh Kumar and Santosh kumar (2010) in snap dragon.

Leaves per Corm

The character days to leaves per corm displayed a significant and positive correlation at both genotypic and phenotypic level for the characters diameter of 1^{st} flower (r_g 1.01; r_p 0.33) and diameter of 3^{rd} floret (r_g 0.84; r_p 0.26). whereas, negative correlation at genotypic and phenotypic levels for the characters recorded in no. of cormels per plant (r_g - 0.68; r_p - 0.28) and shoot per corm (r_g - 0.77; r_p - 0.47).

No. of leaves per corm showed significantly positive correlation with the trait diameter of 1^{st} flower and diameter of 3^{rd} floret at both genotypic and phenotypic level which indicates the importance photosynthetic area for these characters. Whereas recorded negative correlation at both genotypic and phenotypic level with traits no. of cormels per plant and shoots per corm which indicates that increase in leaf number results in length of shoot. The results are in accordance with Zorana *et al.*, (2011), Bazzaz *et al.*, (2007), Jhon *et al.*, (2002), Neeraj *et al.*, (2001) in gladiolus, Gangadhara *et al.*, (2008) in tuberose.

Leaf Area

The character days to leaf area estimated a significant and positive correlation at both genotypic and phenotypic level for the characters, number of partially opened flower (r_g 0.46; r_p 0.30) and weight of daughter corms (r_g 0.56; r_p 0.27) whereas significant and negative correlation of character leaf area at both genotypic and phenotypic level was recorded for character durability of spikes (r_g - 0.28; r_p - 0.29).

Leaf area was positively and significantly correlated with number of partially opened flower and weight of daughter corms and negatively correlated with character durability of spike. Similar work was carried out by Zorana *et al.*, (2011).

50% Heading

The character days to leaf area displayed a significant and positive correlation at both genotypic and phenotypic level for the characters, days to 1^{st} floret initiation (r_g 0.96; r_p 0.94), spike length (r_g 0.46; r_p 0.33), number of florets per spike (r_g 0.38; r_p 0.29), plant height at spike fully opened (r_g 0.47; r_p 0.39), days to senescence of 1^{st} flower (r_g 0.90; r_p 0.88) and days to last flower opening (r_g 0.88; r_p 0.82). Whereas, significant and negative correlation was recorded by this parameter with one character that is durability of spikes (r_g -0.69; r_p -0.57).

Days to 50% heading significantly and positively correlated with days taken for days to 1^{st} floret initiation, spike length, number of florets per spike, plant height at spike fully opened days to senescence of 1^{st} flower and days last floret opening indicating that earlier flowering results in earlier opening of floret. The results are in consonance with Sakkeer Hussain *et al.*, (2001), Manjunath *et al.*, (1997) and Anuradha *et al.*, (1994).

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Days to 1st Floret Initiation

Days to 1st floret initiation has shown significant and positive correlation at both genotypic and phenotypic level with spike length (r_g 0.48;r_p 0.35), rachis length (r_g 0.50; r_p 0.36), no. of floret per spike (r_g 0.42; r_p 0.32), plant height at spike fully opened (r_g 0.48; r_p 0.38), days to senescence of 1st floret (r_g 0.97; r_p 0.97), diameter of 1st flower (r_g 0.48; r_p 0.30), days to last floret opening (r_g 0.95; r_p 0.90). Whereas, significant and negative correlation was recorded by this parameter with only one character that is durability of spikes (r_g - 0.64; r_p - 0.53).

Days to 1st floret initiation showed significantly positive relation at bot genotypic and phenotypic level with characters spike length, rachis length, no. of floret per spike, plant height at spike fully opened, days to senescence of 1st floret, diameter of 1st flower, days to last floret opening. This indicated a smaller number of days took for basal floret to open had more spike length, rachis length, plant height at spike fully opened, diameter of 1st and 3rd floret, and days to last floret opening. The result is in conformity with Balarama and Janakiram (2009), Verma (2004) Jhon *et al.,* (2002) and Neeraj *et al.,* (2001).

Spike Length

Character spike length had recorded significant and positive correlation at both genotypic and phenotypic level with characters rachis length (r_g 0.98;r_p 0.98), no. of floret per spikes (r_g 0.89;r_p 0.78), senescence of last floret (r_g 0.55;r_p 0.37), plant height at spike fully opened (r_g 0.87;r_p 0.80), days to senescence of 1st floret (r_g 0.54;r_p 0.42), diameter of 1st flower(r_g 0.75;r_p 0.27), diameter of 3rd floret (r_g 0.55;r_p 0.31) and days to last floret opening (r_g 0.57;r_p 0.40), whereas for this parameter no negative significant correlation was recorded.

Spike length was positively correlated with rachis length, no. of florets per spikes, senescence of last floret, plant height at spike fully opened, days to senescence of 1st floret, diameter of 3rd floret and days to last floret opening. These findings are in agreement with Jhon *et al.,* (2002) who observed that spike length is an important character for cut flower production which has more economically feasible value which can be increased with increase of any one the characters, expect a few. Especially the emphasis may be laid down upon the plant height, number of florets or diameter of the floret. Since these characters had highly significant positive correlations with spike length so a direct selection from genotypes will be more effective for improvement of this crop.

Similar results were reported by Sisodia *et al.,* (2018), Verty*et al.,* (2017), Aasia*et al.,* (2016), Balaram and janakiram (2009), Verma (2004), Jhon *et al.,* (2002), Neeraj *et al.,* (2001), Singh *et al.,* (2000) and Hegde (1994) in gladiolus, Gangadharappa*et al.,* (2008) in Tuberose and Rakesh Kumar and Santosh Kumar (2010) in Snap dragon.

Rachis Length

Character Rachis length had recorded significant and positive correlation at both genotypic and phenotypic level for the characters, no of florets per spike (r_g 0.89;r_p 0.76), senescence of last floret (r_g 0.53;r_p 0.35), plant height at spike fully opened (r_g 0.86;r_p 0.79), days to senescence of 1st flower (r_g 0.55;r_p 0.43), diameter of 3rd floret (r_g 0.50;r_p 0.30) and days to last floret opening (r_g 0.56;r_p 0.39). Whereas, significant and negative correlation was recorded for this parameter only one character that is durability of spikes (r_g - 0.64; r_p - 0.28).

Positive and significant association was recorded for rachis length with no. of florets per spike, senescence of last floret, plant height at spike fully opened, days to senescence of 1st flower, diameter of 1st floret, diameter of 3rd floret and days to last floret opening and negatively correlated at both genotypic and phenotypic level with trait durability of spike which indicates that more length of rachis will lead to more No. of florets, plant height, more days to senescence of florets. Small rachis length directly affects the durability of spikes. Hussain *et al.,* (2001), Anuradha *et al.,* (2002), Lepcha *et al.,* (2007), Kumar et el. (2013) and Thakur *et al.,* (2015) reported similar observation in gladiolus.

No. of florets per spike

Character no. of florets per spike had recorded significant and positive correlation at both genotypic and phenotypic level for the characters, senescence of last floret (r_g 0.45;r_p 0.33), plant height at spike fully opened (r_g 0.81;r_p 0.68), number of partially opened flower (r_g 0.31;r_p 0.28), days to senescence of 1st flower (r_g 0.45;r_p 0.36) and days to last floret opening (r_g 0.48;r_p 0.37), whereas at genotypic level correlation had been recorded negative with parameter *viz.,* no. of corms per plant, diameter of daughter corms, number of cormels per plant.

No. of florets per spike showed significant and positive correlation at both genotypic and phenotypic level with characters senescence of last flower, plant height at spike fully opened, number of partially opened flower, days to senescence of 1st flower and days to last floret opening and in consonance with Neeraj *et al.,* (2001), Bichoo*et al.,* (2002), Nimbalkar*et al.,* (2007), ahmad*et al.,* (2008) and Verty*et al.,* *(*2017). The above character which showed positive significant correlation with number of florets per spike should be taken into consideration for selection point of view.

Senescence of last floret

Senescence of last floret had displayed significant and positive correlation at both genotypic and phenotypic level for the characters, plant height at spike fully opened (r_g 0.52; r_p 0.39), days to senescence of 1st flower (r_g 0.93; r_p 0.89), diameter of 1st flower (r_g 0.79; r_p 0.40), diameter of 3rd floret (r_g 0.78; r_p 0.45) and days to last floret opening (r_g 0.95; r_p 0.95).
Whereas, at genotypic level, few characters displayed negative correlation with this parameter *viz.*, durability of spikes and no. of daughter corms.

Senescence of last floret displayed a positive and significant correlation with characters plant height at spike fully opened, days to senescence of 1st flower, diameter of 1st flower, diameter of 3rd floret and days to last floret opening similar results were also reported by Jhon *et al.,* (2002), Balaram and Janakiram (2009) and Verty*et al.,* (2017).

Plant height at spike fully opened

The characterplant height at spike fully opened displayed a positive correlation at both genotypic and phenotypic level for the characters, days to senescence of 1st flower (r_g 0.58; r_p

0.48), diameter of 1^{st} flower (r_g 0.55; r_p 0.28), diameter of 3^{rd} floret (r_g 0.44; r_p 0.33) and days to last floret opening (r_g 0.58; r_p 0.44).

Whereas, significant and negative correlation was recorded with only one character that is durability of spike (r_g - 0.40; r_p - 0.31), and at genotypic level trait diameter of daughter corms had also shown a negative and significant correlation with this parameter.

Plant height at spike fully opened was positively and significantly correlated at both genotypic and phenotypic level for characters days to senescence of 1^{st} floret, diameter of 1^{st} flower, diameter of 3^{rd} floret and days to last floret opening. This result is supported by the findings of Lal *et al.*, (1985), Gowda (1989), Misra and Saini (1990), Jhon *et al.*, (2002), Choudhary *et al.*, (2011), Balaram and Janakiram(2009), Kumar *et al.*, (2013) and Sisodia *et al.*, (2018).

No. of partially opened flower

For no. of partially opened flower, traits like days to senescence of 1^{st} flower, diameter of 1^{st} flower, diameter of 3^{rd} floret, days to last floret opening and diameter of daughter corms have shown positive and significant correlation at genotypic level.

Days to senescence of 1^{st} flower

The characterdays to senescence of 1^{st} flower displayed a positive correlation at both genotypic and phenotypic level for the characters, diameter of 1^{st} flower (r_g 0.56; r_p 0.33), diameter of 3^{rd} floret (r_g 0.51; r_p 0.31), days to last floret opening (r_g 0.99; r_p 0.95), whereas, significant and positive correlation was recorded in character durability of spikes (r_g - 0.60; r_p - 0.50).

For days to senescence of 1^{st} floret displayed a positive and significant correlation at both genotypic and phenotypic level with characters diameter of 1^{st} flower, diameter of 3^{rd} floret, days to last floret opening similar findings were reported by Singh *et al.*, (1983) and Anuradha *et al.*, (1994).

Diameter of 1^{st} flower

The characterdiameter of 1^{st} flower displayed a positive correlation at both genotypic and phenotypic level for the characters, diameter of 3^{rd} floret (r_g 1.01;r_p 0.71), days to last floret opening (r_g 0.57;r_p 0.28), and at genotypic level characters durability of spike also recorded a positive correlation with this character.

Diameter of 1^{st} flower showed a significant and positive correlation with characters diameter of 3^{rd} floret and days to last floret opening. Hence, selection based on these characters is important for improving floret diameter and results are in conformity with the findings of misra and Saini (1990), Singh *et al.*, (2000), Anuradha *et al.*, (2002), Sakkeer Hussain (2007), Balaram and Janakiram (2009), Thakur *et al.*, (2015) and Vertyet *al.*, (2017) in gladiolus.

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Diameter of 3^{rd} floret

The characterdiameter of 3^{rd} floret displayed a positive correlation at both genotypic and phenotypic level for the characters, durability of spike (r_g 0.25;r_p 0.38) and days to last floret opening (r_g 0.55;r_p 0.32) whereas as at genotypic level, trait shoots per corm recorded negatively significant for this character.

There exists a positive and significant relationship of diameter of 3rd floret with durability of spike and days to last floret opening.at both genotypic and phenotypic level. Similar results were reported by Anuradha *et al.,* (2002), Archana *et al.,* (2008), Balaram and Jankiram (2009), Thakur *et al.,* (2015) and Verty*et al.,* (2017).

Durability of spike

Character durability of spikes exhibits significant negative correlation with characters days to last floret opening (r_g - 0.54;r_p - 0.27) and number of cormels per plant (r_g - 0.53;r_p - 0.32).

There exists a negatively significant relationship of durability of spike with character days to last floret opening and number of cormels per plant. This indicates that if the durability of spike is low, less will be the days to last floret opening and less no. of cormels per plant.

Days to last floret opening

Character days to last floret opening doesn't display any significant correlation with other characters.

No. of Corms per plant

The characterno. of corms per plant exhibits a significant and positive correlation at both genotypic and phenotypic level for the character shoots per corm (r_g 0.30;r_p 0.28), whereas this character recorded positive correlation with diameter of daughter corms and number of cormels per plant at genotypic level.

Good multiplication ratio is very much essential for expansion of any crop. Number of corms per plant showed significantly positive correlation with Shoots per corm.as in agreement with Neeraj *et al.,*(2001), Balaram and Jankiram (2009), Aaditya*et al.,* (2011), Ahmad *et al.,* (2012), Thakur *et al.,*(2015) and Verty*et al.,* (2017) in gladiolus indicating that with increase in the no. of shoots and spikes the total corm production increases.

Weight of daughter corms

The characterweight of daughter corms exhibits a significant and positive correlation at both genotypic and phenotypic level for the character, diameter of daughter corms (r_g 0.94;r_p 0.64) and at genotypic level this character recorded positive correlation with characters *viz.,* no. of cormels per plant and no. of daughter corms.

Weight of daughter corms showed a positive correlation with diameter of daughter corms at both genotypic and phenotypic level and similar trend was reported by Neeraj *et al.,* (2001), Nimbalkar*et al.,* (2007), Janakiram (2009), Thakur *et al.,* (2015) and Verty*et al.,* (2017). Pointing that increase in the diameter of daughter corm result in the increase in weight of daughter corm weight

Diameter of daughter corms

Diameter of daughter corm exhibits a significant and positive correlation with no. of cormels per plant (r_g 0.35;r_p 0.34).

Corm diameter was recorded to be positively and significantly associated with no. of cormels per plant at both genotypic and phenotypic level indicated that with increase in size of daughter corm no. of cormels can also be increased. Similar findings were reported by Neeraj *et al.*, (2001), Jhon *et al.*, (2002) Balaram and Janakiram (2009)

No. of cormels per plant

Traitno. of cormels per plant exhibits a significant and positive correlation at both genotypic and phenotypic level for the character, no. of daughter corms (r_g 0.75;r_p 0.47).

Conclusion

Based on the above investigation, it can be concluded that cultivars were having substantial diversity and variability for most of the characters. A promising gladiolus cultivar with number of florets per spike could be obtained by selection on the basis of plant height, weight of corm and size of corm. Therefore, selection should be based on spike length, number of florets per spike and floret size for better cultivars. Further studies on correlation among the characters and its relation with spike length, plant height, number of florets per spike and number of corms produced per mother corm are recommended for better information and understanding the improvement process.

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characters	D5S	DSI	PHFS	LPC	LA	5H	DFFI	SL	RL	NFPS	SLF	PHSFO	NPOF	DSFF	DFF	DTF	DS	DLFO	NCP	WDC	DDC	NCP	NDC	SC
D5S	1**																							
DSI	0.190^{NS}	1**																						
PHFS	0.316^{*}	0.472^{**}	1**																					
LPC	0.086^{NS}	-0.133^{NS}	0.166^{NS}	1**																				
LA	0.158^{NS}	0.180^{NS}	0.082^{NS}	0.053^{NS}	1**																			
5H	0.246^{NS}	0.446^{**}	0.543^{**}	-0.050^{NS}	0.184^{NS}	1**																		
DFFI	0.176^{NS}	0.436^{**}	0.592^{**}	0.064^{NS}	0.249^{NS}	0.949^{**}	1**																	
SL	0.106^{NS}	0.268^{*}	0.491^{**}	0.067^{NS}	0.066^{NS}	0.336^{**}	0.352^{**}	1**																
RL	0.155^{NS}	0.280^{*}	0.441^{**}	0.053^{NS}	0.134^{NS}	0.356^{**}	0.361^{**}	0.985^{**}	1**															
NFPS	0.074^{NS}	0.067^{NS}	0.324^{*}	-0.077^{NS}	0.190^{NS}	0.298^{*}	0.321^{*}	0.781^{**}	0.768^{**}	1**														
SLF	0.182^{NS}	0.400^{**}	0.593^{**}	0.125^{NS}	0.120^{NS}	0.725^{**}	0.830^{**}	0.371^{**}	0.351^{**}	0.339^{**}	1**													
PHSFO	0.076^{NS}	0.344^{**}	0.383^{**}	-0.113^{NS}	0.059^{NS}	0.395^{**}	0.388^{**}	0.801^{**}	0.793^{**}	0.688^{**}	0.390^{**}	1**												
NPOF	-0.074^{NS}	0.067^{NS}	0.059^{NS}	0.001^{NS}	0.307^{*}	0.186^{NS}	0.220^{NS}	0.147^{NS}	0.146^{NS}	0.287^{*}	0.206^{NS}	0.225^{NS}	1**											
DSFF	0.127^{NS}	0.485^{**}	0.578^{**}	0.064^{NS}	0.237^{NS}	0.884^{**}	0.957^{**}	0.424^{**}	0.431^{**}	0.363^{**}	0.896^{**}	0.480^{**}	0.236^{NS}	1**										
DFF	0.324^{*}	0.282^{*}	0.523^{**}	0.333^{**}	0.226^{NS}	0.203^{NS}	0.303^{*}	0.271^{*}	0.275^{*}	0.135^{NS}	0.400^{**}	0.284^{*}	0.076^{NS}	0.339^{**}	1**									
DTF	0.269^{*}	0.230^{NS}	0.478^{**}	0.260^{*}	0.165^{NS}	0.158^{NS}	0.253^{NS}	0.314^{*}	0.305^{*}	0.200^{NS}	0.456^{**}	0.339^{**}	0.076^{NS}	0.316^{*}	0.715^{**}	1**								
DS	0.068^{NS}	-0.311^{*}	-0.144^{NS}	0.100^{NS}	-0.298^{*}	-0.573^{**}	-0.532^{**}	-0.230^{NS}	-0.283^{*}	-0.156^{NS}	-0.064^{NS}	-0.318^{*}	-0.130^{NS}	-0.501^{**}	0.018^{NS}	0.176^{NS}	1**							
DLFO	0.138^{NS}	0.457^{**}	0.571^{**}	0.010^{NS}	0.145^{NS}	0.826^{**}	0.901^{**}	0.401^{**}	0.391^{**}	0.371^{**}	0.957^{**}	0.448^{**}	0.244^{NS}	0.954^{**}	0.285^{*}	0.329^{*}	-0.279^{*}	1**						
NCP	-0.193^{NS}	0.058^{NS}	-0.007^{NS}	0.019^{NS}	-0.242^{NS}	-0.072^{NS}	-0.019^{NS}	-0.082^{NS}	-0.134^{NS}	-0.235^{NS}	0.010^{NS}	0.070^{NS}	-0.104^{NS}	0.011^{NS}	0.125^{NS}	-0.024^{NS}	-0.005^{NS}	0.009^{NS}	1**					
WDC	0.126^{NS}	-0.071^{NS}	-0.292^{*}	-0.142^{NS}	0.279^{*}	0.043^{NS}	0.020^{NS}	-0.154^{NS}	-0.075^{NS}	-0.011^{NS}	-0.007^{NS}	-0.112^{NS}	0.107^{NS}	-0.006^{NS}	-0.137^{NS}	-0.112^{NS}	0.000^{NS}	0.014^{NS}	-0.014^{NS}	1**				
DDC	-0.064^{NS}	-0.163^{NS}	-0.213^{NS}	-0.102^{NS}	0.164^{NS}	0.064^{NS}	0.072^{NS}	-0.187^{NS}	-0.130^{NS}	-0.124^{NS}	0.024^{NS}	-0.156^{NS}	0.128^{NS}	0.055^{NS}	-0.202^{NS}	-0.192^{NS}	-0.075^{NS}	0.038^{NS}	0.161^{NS}	0.675^{**}	1**			
NCP	0.040^{NS}	0.239^{NS}	-0.044^{NS}	-0.287^{*}	-0.037^{NS}	0.200^{NS}	0.109^{NS}	-0.119^{NS}	-0.075^{NS}	-0.230^{NS}	-0.072^{NS}	-0.035^{NS}	-0.144^{NS}	0.083^{NS}	-0.226^{NS}	-0.170^{NS}	-0.326^{*}	0.045^{NS}	0.142^{NS}	0.232^{NS}	0.343^{**}	1**		
NDC	0.133^{NS}	0.090^{NS}	0.001^{NS}	-0.120^{NS}	-0.110^{NS}	-0.085^{NS}	-0.113^{NS}	0.133^{NS}	0.162^{NS}	0.050^{NS}	-0.230^{NS}	0.112^{NS}	0.073^{NS}	-0.112^{NS}	-0.123^{NS}	-0.063^{NS}	-0.197^{NS}	-0.153^{NS}	-0.037^{NS}	0.112^{NS}	0.154^{NS}	0.476^{**}	1**	
SC	-0.145^{NS}	0.059^{NS}	-0.140^{NS}	-0.477^{**}	-0.420^{**}	-0.103^{NS}	-0.156^{NS}	-0.150^{NS}	-0.189^{NS}	-0.044^{NS}	-0.106^{NS}	-0.025^{NS}	-0.045^{NS}	-0.174^{NS}	-0.194^{NS}	-0.166^{NS}	0.183^{NS}	-0.077^{NS}	0.284^{*}	0.134^{NS}	0.191^{NS}	0.100^{NS}	0.016^{NS}	1**

Table 1: Phenotypic coefficient correlations for 24 traits.

characters	D5S	DSI	PHFS	LPC	LA	5H	DFFI	SL	RL	NFPS	SLF	PHSFO	NPOF	DSFF	DFF	DTF	DS	DLFO	NCP	WDC	DDC	NCP	NDC	SC
D5S	**1****																							
DSI	0.311*	**1****																						
PHFS	0.320*	0.616**	**1****																					
LPC	0.380**	-0.304*	0.543**	**1****																				
LA	0.213^{NS}	0.237^{NS}	0.078^{NS}	-0.016^{NS}	**1****																			
5H	0.307*	0.585**	0.616**	-0.027^{NS}	0.203^{NS}	**1****																		
DFFI	0.241^{NS}	0.541**	0.679**	0.121^{NS}	0.284*	0.966**	**1****																	
SL	0.132^{NS}	0.430**	0.684**	-0.109^{NS}	0.042^{NS}	0.460**	0.489**	**1****																
RL	0.211^{NS}	0.453**	0.632**	-0.154^{NS}	0.134^{NS}	0.489**	0.501**	0.980**	**1****															
NFPS	0.112^{NS}	0.108^{NS}	0.446**	-0.201^{NS}	0.185^{NS}	0.380**	0.421**	0.898**	0.897**	**1****														
SLF	0.250^{NS}	0.501**	0.713**	0.447**	0.192^{NS}	0.776**	0.883**	0.553**	0.538**	0.456**	**1****													
PHSFO	0.053^{NS}	0.564**	0.575**	-0.230^{NS}	0.060^{NS}	0.471**	0.488**	0.871**	0.862**	0.813**	0.522**	**1****												
NPOF	0.015^{NS}	0.253^{NS}	0.334**	-0.170^{NS}	0.466**	0.273*	0.370**	0.314*	0.332**	0.316*	0.356**	0.303*	**1****											
DSFF	0.193^{NS}	0.584**	0.652**	0.160^{NS}	0.267*	0.903**	0.970**	0.548**	0.558**	0.459**	0.934**	0.583**	0.429**	**1****										
DFF	0.565**	0.470**	0.879**	1.014**	0.366**	0.356**	0.485**	0.759**	0.741**	0.494**	0.799**	0.557**	0.552**	0.565**	**1****									
DTF	0.391**	0.399**	0.934**	0.844**	0.281*	0.263*	0.432**	0.558**	0.502**	0.444**	0.788**	0.445**	0.363**	0.510**	1.010**	**1****								
DS	0.035^{NS}	-0.455**	-0.167^{NS}	0.560**	-0.289*	-0.698**	-0.640**	-0.242^{NS}	-0.304*	-0.219^{NS}	-0.285*	-0.406**	-0.361**	-0.609**	0.256*	0.381**	**1****							
DLFO	0.187^{NS}	0.567**	0.677**	0.196^{NS}	0.213^{NS}	0.882**	0.956**	0.570**	0.568**	0.483**	0.951**	0.583**	0.412**	0.991**	0.572**	0.554**	-0.548**	**1****						
NCP	-0.274*	0.040^{NS}	0.015^{NS}	0.224^{NS}	-0.262*	-0.059^{NS}	0.011^{NS}	-0.162^{NS}	-0.234^{NS}	-0.397**	0.053^{NS}	0.055^{NS}	-0.308*	0.046^{NS}	-0.016^{NS}	-0.128^{NS}	-0.007^{NS}	0.044^{NS}	**1****					
WDC	0.157^{NS}	-0.197^{NS}	-0.400**	-0.422**	0.563**	0.051^{NS}	0.017^{NS}	-0.195^{NS}	-0.032^{NS}	-0.150^{NS}	-0.108^{NS}	-0.056^{NS}	0.204^{NS}	-0.037^{NS}	-0.162^{NS}	-0.166^{NS}	-0.141^{NS}	-0.060^{NS}	-0.092^{NS}	**1****				
DDC	-0.130^{NS}	-0.283*	-0.507**	-0.032^{NS}	0.346**	0.052^{NS}	0.071^{NS}	-0.673**	-0.543**	-0.621**	-0.047^{NS}	-0.392**	0.534**	0.007^{NS}	0.087^{NS}	-0.163^{NS}	-0.123^{NS}	-0.013^{NS}	0.312*	0.945**	**1****			
NCP	0.032^{NS}	0.256*	-0.054^{NS}	-0.685**	-0.073^{NS}	0.318*	0.168^{NS}	-0.109^{NS}	-0.042^{NS}	-0.277*	-0.106^{NS}	0.051^{NS}	-0.167^{NS}	0.113^{NS}	-0.281*	-0.223^{NS}	-0.537**	0.058^{NS}	0.343**	0.307*	0.353**	**1****		
NDC	0.262*	-0.011^{NS}	0.055^{NS}	-0.826**	-0.340**	-0.071^{NS}	-0.223^{NS}	0.127^{NS}	0.190^{NS}	0.028^{NS}	-0.393**	0.305*	0.153^{NS}	-0.239^{NS}	-0.260*	-0.019^{NS}	-0.230^{NS}	-0.227^{NS}	0.021^{NS}	0.302*	-0.084^{NS}	0.752**	**1****	
SC	-0.329*	0.071^{NS}	-0.250^{NS}	-0.770**	-0.482**	-0.128^{NS}	-0.220^{NS}	-0.141^{NS}	-0.220^{NS}	-0.092^{NS}	-0.181^{NS}	0.083^{NS}	0.007^{NS}	-0.233^{NS}	-0.572**	-0.511**	0.224^{NS}	-0.133^{NS}	0.307*	-0.206^{NS}	0.014^{NS}	0.243^{NS}	0.061^{NS}	**1****

Table 2: Genotypic coefficient correlations for 24 traits.

D5S: days to 50% sprouting
DSI: days to spike initiation
PHFS: plant height at flowering stage
LPC: leaves per corm
LA: leaf area
5H: 50% heading

DFFI: days to first floret initiation
SL: spike length
RL: Rachis length
NFPS: no. of florets per spike
SLF: senescence of last floret
PHSFO: plant height at spike fully opened

NPOF: no. of partially opened flower
DSFF: days to senescence of first flower
DFF: diameter of first flower
DTF: diameter of third floret
DS: durability of spike
DLFO: days to last floret opening

NCP: number of corms per plant
WDC: weight of daughter corm
DDC: diameter od daughter corm
NCP: no. of cormels per plant
NDC: number of daughter corms
SC: shoots per corm

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