Original Research Article

Correlation and Heritability Analysis for Seed Quality Under Controlled Conditions in Wheat (*Triticum aestivum* L.)

Abstract

A study was conducted on wheat (*Triticum aestivum* L.) in laboratory at Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya, Uttar Pradesh, during the 2019–20 for correlation and heritability analysis for seed quality under controlled conditions in wheat. In a wheat crop research, 30 germplasm were tested using three checks each for the parameters of seed weight, seed width, seed length, shoot length, root length, seedling length, seedling dry weight, germination (%), first count, final count, and vigour index-I and vigour index-II. In this study, the germplasm was assessed using parameters and the correlation coefficient. The vigour index-II demonstrated a very significant positive phenotypic connection with root length (0.828), final count (0.564), and first count (0.552), as well as a genotypically significant positive correlation with final count (1.165), root length (0.867), and first count (0.552).

Thehighestimates(>15%)ofphenotypiccoefficientofvariation(PCV)andgenotypiccoefficientofvariation (GCV) were registered in the case of vigourindex-I(PCV=17.36%,GCV=17.24%),shoot length (PCV=15.96%, GCV= 15.77%), seed width(PCV=15.35%,GCV=15.19%).Themoderate estimate (10%) of PCV and GCV were recorded forrootlength (PCV=12.72%, GCV=12.56%), and seedlinglength(PCV=11.46,GCV=11.30).

Keyword– *Correlation, Germplasm, Vigour, Laboratory*

Introduction- Wheat is a cereal crop. In India, it is predominantly cultivated in Haryana, Punjab, Madhya Pradesh, Uttar Pradesh, Rajasthan, Chattisgarh, etc. Globally,wheat (*Tritium spps*.) is being grown up on about 220.83millionhectares land holdingthepositionofhighest acreage amongallcropswith the annualproductionhoveringaround769.31milliontons[1].In India, it's grown on an area of 30.55 million hectares withaproduction and productivity of107.18milliontonsand3508 kg/ha, respectively. In India, the highest area covered underwheatcultivation is inUttar Pradesh i.e 9.54millionhectareswith a production of 32.75 milliontonnes and productivity 3432 kg/ hectare. The highestproductivity5183kg/hectareinPunjabandlowermostproductivity1666kg/hectare was reportedinMaharashtra [2]. The global main wheat producing countries are China, India, USA,Russia,Australia,Germany,France,Pakistan,Argentina,Turkey,IranandItaly.Withtheincreasi ng world population, demand of wheat cropisprojectedtoincrease by60 per cent by2050,this increment may influences up to 9.7 billion people obviously as suggested by the Unite Nations [3]. Aconstant increase in agriculture productionandproductivityessentiallyrequirescontinuousexpansionoflatestandimprovedtypesofcro psandefficient scheme of production and also offer of quality seed to the farmers.Seedqualitywithinthesumofthesequalitiesdifferentiatetheseedfromthegrain.The important seed quality attributes are geneticpurity,physicalpurity,germination,moisture, free from insect pest and disease andvigour.Inaddition, toabovequality, seed should also be of unchanging size and willhave good lusture. Germination capacity of superiority seedportionshouldbehighforgainingthespecifiedcropsupernumerarythissector.Usingseedoflowger mination will diminish the sphere establishmentor stand and thus the yields would be dropped. Seedgerminationisdepends onarangeofthings whichiscompulsoryduringitsformation, maturing, ripening and also infection withthepestandpathogen. The subidealconditionofnutrients and water and precocious rains or frost atthematuritystage and also post-harvestoperations and management of the seed lots duringmarketingorsupplyareaffectingthe seed quality.

Materialandmethods

The experiment was carried out during 2020-21 atAcharyaNarendraDevaUniversityofAgricultureandTechnology Kumarganj Ayodhya (U.P.)

Laboratory Department of seed science and technology (GPB).The experiment wasconducted to evaluate the 30germplasmwiththreechecks(PBW-343,NW-1014,NW-5054) in a completely randomized design. The experiment was conducted in the laboratory by placing four replications (Acc. to ISTA). The datawas recordedon10randomlyselectedseedsandseedlingsforthirteencharactersviz.1000-seedweight (g), Seed length (mm), Seed breadth (mm),Shootlength(cm),Rootlength(cm),Seedlinglength (cm), Seedling Dry Weight (mg), Speed ofgermination,Germination(%),Vigourindex-I,Vigour Index–II, First count (%), Final count (%).Datarecordedontheabovecharactersweresubjectedtoestimatethecoefficientofvariation**[4]**, Estimationof heritability**(Hanson, 1963) [5]**and genetic advance **(Johnson, *et al*., 1955) [6],**Vigouranalysis**(AbdulBakiandAnderson, 1973)[7].**

ResultandDiscussion

The study of genetic variability and seed qualityamong30genotypesofwheatalongwiththreeckswasassessedbyemploying the Estimationof coefficient of variation **[4]**, Estimationof heritability**[5]**and genetic advance **[6],** Vigouranalysis**[7].**Thediscrimination of germplasms into four replicationssuggested the presenceof a highdegreeofgeneticvariability in the material evaluated. The estimatethegeneticvariabilityandassessmentofseedqualityrecordedthatthegenotypesShowed variabilitywithrespecttothirteencharactersunderstudy,whilemuch more variability observed in HI-1628, TL-3012,DM-7,WAPD-1519forcharactersSeedlength(mm),Seedbreadth(mm),Shootlength(cm),Rootlength(cm),Seedlingl ength(cm),Vigourindex-I, Vigour Index–II. The analysis of variancefoundhighlysignificantdifferencesforallthecharactersstudied.Therangeofvariationwasmax imum for Vigour Index -II, followed by vigourindex-I,seedlingdryweight,shootlength,rootlength, seedling length, seed germination (%), firstcount, final count, speed of germination, 1000-seedweight,seedwidthandseedlength.Theestimatesofphenotypiccoefficientofvariation(PCV)andge notypiccoefficientofvariation(GCV)for the thirteenthseedqualityparametersofwheatgenotypesarepresentedinTable-1.Theresultshoweda close correspondence between thephenotypicandgenotypicvariancesforallthecharactersindicatingstableexpression.Thehighestim ates(>15%)ofphenotypiccoefficientofvariation(PCV)andgenotypiccoefficientofvariation (GCV)

were registered in the case of vigourindex-I(PCV=17.36%,GCV=17.24%),shoot length (PCV=15.96%, GCV= 15.77%), seed width(PCV=15.35%,GCV=15.19%).Themoderate estimate (10%) of PCV and GCV were recorded forrootlength (PCV=12.72%, GCV=12.56%), and seedlinglength(PCV=11.46,GCV=11.30).The result of the present study in respect of the genotypicandphenotypiccoefficientofvariation is similar to the resultfoundearlierworkersSingh,*etal*.(2017),Geleta,T.(2017), and Prasad, *et.al*.(2020).The magnitude ofheritabilityin the broadsensevariedbetween98.63%incase of vigour index-I to 65.71% for germination(%). The high estimates of [h2 (bs)%] (>75%) were notedin the caseofvigourindex-I(98.63%),seedwidth(98.02%), shoot length (97.62%), root length (97.41%),seedlinglength(97.25%),1000-seedweight (94.11%), seed length (91.71%), speed ofgermination(90.55%),vigourindex-II(90.34%),seedling dry weight (90.12%). Moderate estimatesofheritabilitywererecordedforfirstcount(79.02%),While the finalcount(68.75%)andgerminationpercentage(65.71%)should have lowestimates of heritability (<70%). The estimates of highheritabilitycoupledwithhighgeneticadvancevigour index-I, seed width, and shoot length indicatedthat the heritability of the traits is mainly due to the effectofgenesandselectioniseffectiveforsuchtraits.Theresult obtained under the present investigation is inaccordance with earlier reports by **Akshitha, *etal*.(2020)[8],Lakshmi,*etal*.(2016) [9]**.Theestimatedmediumheritabilityandgeneticadvanceinfirstcount,finalcountandgermination percentage indicating the medium range ofheritabilityandgeneticadvancestudiesearlierworkers **Lakshmi, *et al*.(2016) [9],Sudeepthi,*etal*.(2020) [10]**. Vigour index-II exhibited highly significantandpositivegenotypiccorrelationwithseedlingdryweight(0.810),shootlength(0.423),final count(0.388), vigour index-I (0.380), seed length (0.377),seedwidth(0.361), seedling length(0.317). firstcount(0.196),1000-seedweight(0.253)andgerminationpercentage(0.255)while a significantandpositivecorrelationwasnotedwithvigourindex -IIRestofthe2characterssshowednon-significant correlation with this character is presented in table no3. The phenotypic correlationcoefficientforvigourindex-IIwasfoundhighlysignificant with seedling dry weight (0.721), seedlength(0.350),seedwidth(0.341),shootlength(0.392),38vigourindex-I(0.336),seedlinglength (0.287),germinationpercentage(0.278).Finalcount (0.236)and1000-seedweight(0.214)shows a significantpositivephenotypiccorrelationwithvigour index-II. Rest 3 character showed non-significantcorrelationwiththischaracterispresented in table 3. The quality

seed production andimprovement of variety/germplasm is very complexin nature, quality seed production come through aproperchannelWehavestudiesaboutthe30-germplasmincludingthreechecksbycheckingof13seed quality parameter that are 1000-seed weight,seed width, seed length, shoot length, root length,seedlinglength,seedlingdryweight,firstcount,final count, germination percentage, vigour index-Iand vigour index-II. In this study we found highgenotypicandphenotypiccorrelationcoefficientbetween the seed quality parameter 43 found highpositivesignificantgenotypicallybetweengermination percentage with final count, seedlinglengthwithrootlengthrevealedbyearlierresearchers like**Kumar, *et al.*(2017) [11], Olawamide, *et al.* (2018) [12], Manjeet, *et al.*(2020) [13].**Thestudyconductedunderlaboratoryconditionsforcheckedthequalityofdifferentgermplasm highly significant phenotypic correlationfoundbetweenseedlinglengthwithrootlength,seedlinglengthwithshootlength, and germinationpercentage with final count found by earlier workerslike **Shobha, *et al.* (2020), Panwar, *et al.* (2018),Wen,*etal*.(2017) [14, 15, 16].**

Conclusion

The analysis of the experiment revealed extremely significant differences for all the features, contributing attributes to seed quality under study, among the 30 genotypes and 3 checks of wheat (*Triticum aestivum* L). All of the characteristics have extremely significant relationships, Seed length (0.377), seed width (0.361), shoot length (0.423), seedling length (0.317), seedling dry weight (0.810), final count (0.388), and vigour index-I (0.380) all exhibited extremely high positive correlations with each other.According to the overall findings, it appears that some of the information gathered here will be useful for enhancing and choosing the dominant wheat genotype like HI - 1628, DM- 7, HI-1009 and TL- 3012 etc.

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Table1:Estimatesofrange,grandmean,phenotypic(PCV)andgenotypic(GCV)coefficientofvariation,heritabilityin a broadsense[h^2(bs)%]andgeneticadvanceinpercentofmean(Ga %)forthirteencharactersinwheatgenotypes

Characters	Range (Min. – Max.)	Mean($\bar{x}$)	PCV(%)	GCV(%)	Heritability [h^2 (bs)%]	Geneticadvanceinpercentof5%mean(Ga%)
1000 SeedWeight(g)	28.52-44.85	39.95	8.88	8.62	94.11	17.22
SeedLength(mm)	5.62-7.25	6.36	8.74	8.37	91.71	16.51
SeedWidth(mm)	2.69-4.18	3.43	15.35	15.19	98.02	30.99
ShootLength (cm)	5.60-12.70	9.72	15.96	15.77	97.62	32.10
RootLength (cm)	10.00-17.00	13.93	12.72	12.56	97.41	25.53
Seedling Length(cm)	17.50-29.30	23.87	11.46	11.30	97.25	22.97
Speedofgermination	17.34-22.32	19.59	6.97	6.63	90.55	13.00
SeedlingDry Weight(mg)	123.0-163.0	145.2	6.94	6.59	90.12	12.89
FirstCount	72.00-88.00	80.91	4.73	4.20	79.02	7.70
FinalCount	82.00-94.00	87.85	3.92	3.25	68.75	5.55
GerminationPercentage	85.31-94.86	88.82	3.36	2.72	65.71	4.54

VigourIndex-I	1540.0-3637	2106.4	17.36	17.24	98.63	35.27
VigourIndex -II	10824-14507	12631	7.47	7.10	90.34	13.90

Table2:Estimatesofphenotypiccorrelationcoefficientbetweendifferentcharactersinwheatgenotypes

Characters	SeedLength(mm)	SeedWidth(mm)	ShootLength(cm)	RootLength(cm)	SeedlingLength(cm)	Speedofgermination	Seedli
1000SeedWeight(g)	**0.251***	-0.149	-0.014	-0.080	-0.052	0.130	
SeedLength(mm)		**0.396****	0.179	-0.203*	-0.026	-0.062	
SeedWidth(mm)			**0.215***	0.100	0.186	-0.234*	
ShootLength(cm)				**0.344****	0.782**	0.162	0.124
RootLength(cm)					**0.828****	0.238*	0.062
SeedlingLength(cm)						**0.222***	
Speedofgermination							

SeedlingDryWeight(mg)							
FirstCount							
FinalCount							
GerminationPercentage							
VigourIndex-I							

*,** significantat5%and1%level,respectively

Table3:Estimatesof the genotypiccorrelationcoefficientbetweendifferentcharactersin wheatgenotypes

Characters	SeedLength(mm)	SeedWidth(mm)	ShootLength(cm)	RootLength(cm)	SeedlingLength(cm)	Speedofgermination	Seedling DryWeight(mg)	FirstCount(No.)	FinalCount(No.)	Germination Percentage(%)	VigourIndex-I	VigourIndex-II
1000SeedWeight(g)	**0.315****	-0.168	0.001	-0.093	-0.055	0.144	0.269**	0.006	0.270**	0.281**	-0.036	0.253*
SeedLength(mm)		**0.442****	0.179	-0.207*	-0.032	-0.062	0.425**	-0.223*	0.061	0.022	0.029	0.377**
SeedWidth(mm)			**0.231***	0.099	0.195	-0.255*	0.334**	0.032	-0.033	-0.126	0.168	0.361**
ShootLength(cm)				**0.369****	0.799**	0.186	0.124	0.108	0.424**	0.412**	0.729**	0.423**
RootLength(cm)					**0.867****	0.235*	0.091	0.160	0.174	0.302**	0.679**	0.109
SeedlingLength(cm)						**0.270****	0.124	0.181	0.339**	0.444**	0.848**	0.317**
Speedofger							**-0.052**	0.370**	0.757**	0.817**	0.331*	0.132

mination											*	
SeedlingDry Weight(mg)								**-0.048**	-0.002	0.032	0.136	0.810**
FirstCount									**0.552****	0.461**	0.216*	0.196*
FinalCount										**1.165****	0.463**	0.388**
Germination Percentage											**0.525****	0.255*
VigourIndex-I												**0.380****

*,**significantat5%and1%level,respectively

Table 4:Top-performing genotype relative to average performance

Characters	Genotypes
1000 -Seed Weight (g)	AKAW-3717, DWAP- 1108, DWAP- 1531, HI- 8737, HI- 8802, HI- 8713, HI- 8751, GW- 1339, HI- 1628, TL- 3012, HS-627, HI-1009.
Seed Length (mm)	DWPD- 1516, HI- 8777, HI- 1621, DM- 7, CG- 1018, MP- 1338, GW- 1339, HI- 1628, HS- 645, TL- 3012, HS- 627.
Seed Width (mm)	WAPD- 1505, DWAP- 1530, HI- 8708, HI- 8802, HI- 1620, HI- 8751, DM- 7, GW- 1339, HI- 1628, HS- 645, TL- 3012.
Shoot Length (cm)	WAPD- 1519, HI- 1620, HI- 1621, HI- 8751, MPO- 1336, DM- 7, DM- 6, CG- 1018, GW- 1339, HI- 1628, HI- 1009.
Root Length (cm)	DWPD- 1516, WAPD- 1519, WAPD- 1524, DWAP- 1530, HI- 8708, HI- 1620, HI- 8751, MPO- 1336, DM- 7, DM- 6, CG- 1018.
Seedling Length (cm)	WAPD- 1519, HI- 0765, HI- 1620, HI- 1621, HI- 8751, MPO- 1336, DM- 7, DM- 6, CG- 1018, GW- 1339, HI- 1009.
Speed of germination	AKAW- 4901, WAPD-1519, WAPD-1508, WAPD- 1524, DWAP-1108, DWAP-1531, HI-8737, HI-8751, DM-7, CG-1018, HI-1628, HI- 1009.
Dry Weight (mg)	WAPD-1505, DWPD-1516, WAPD-1524, DWAP-1108, HI-8777, HI-8737, DM-7, DM-6, HS-645, TL-3012, HS-627.
First Count	AKAW-4901, AKAW-3717, WAPD-1519, DWAP-1108, DWAP-1531, HI-1620, HI-1621, HI- 8751, HI-1628, TL-3012, HI-1009.
Final Count	AKAW-3717, WAPD-1519, DWAP-1108, DWAP-1531, HI-8737, HI-8751, DM-7, CG-1018, HI-1628, TL-3012, HI-1009
Germination (%)	AKAW-3717, DWAP-1108, DWAP-1531, HI-8737, HI-8751, MPO-1336, DM-7, CG-1018, HI-1628, TL-3012, HI-1009.
Vigour Index -I	WAPD-1519, DWAP-1108, DWAP-1531, HI-1620, HI-8751, MPO-1336, DM-7, DM-6, CG-1018, HI-1628, HI-1009.
Vigour Index -II	WAPD-1505, HI-8708, HI-8777, HI-8737, HI-8751, DM-7, DM-6, HI-1628, TL-3012.