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Research Article

ESTIMATION OF VARIABILITY AND HERITABILITY FOR MORPHOLOGICAL TRAITS AND LEAF RUST SEVERITY IN SPRING WHEAT

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Abstract

The seed materials were received from National Wheat Research Program, Bhairahawa and field experiment was conducted at Regional Agricultural Research Station Tarahara during 2012 and 2013 in wheat growing season. The topography of the experimental site was 130 masl with sandy loam soil. The trial included 24 wheat genotypes laid out in alpha lattice design in eight sub blocks within two main blocks. The eastern region of Nepal has been facing the problem of sterility caused by different stresses during reproductive growth stage. So we need to develop the early maturing variety with high yielding potential that could escape the reproductive damage from rainfall, hot westerly wind and leaf rust epidemic. In this study, we identified BL3594, NL1026, NL297, BL3978 and NL1140 as early maturing wheat genotypes with 102, 102, 101, 97 and 102 days of maturity, respectively. The genotypes varied significantly for heading days, maturity days, plant height, spikes per meter square, grain per spikes and grain yield ton per hector. The most stable yield producing genotypes were BL3264, BL3535, BL3623, NL1135 and BL3978. The variety BL3978 had maturity duration of 97 days, even earlier than check variety NL297. The genotypes NL1093 and NL1094 had highest grain per spikes although had negative correlation coefficient with panicle length consequently led to the lower yield. The new genotypes like BL3978, BL3594 and NL1140 should be promote as appropriate varieties for terai region of Nepal.

Key words: Wheat; Genotypes; Yield, stress; Eastern terai

Introduction

Bread wheat (*Triticum aestivum* L.) is the third cereal crop in Nepal after rice and maize and plays an important role in the country's food security. The crop covers 0.75 million ha of land and produces 1.73 million ton with an average yield of 2.29t/ha (MoAD, 2013). Its productivity was 2.6 t/ha in Sunsari during 2013 (MoAD, 2012/13), lower than national average and above 85% of wheat is grown under rice-wheat system in the country. Soil micronutrient deficiencies are widespread in the 12 million hectares in South Asia where the rice-wheat system is followed (Bergale *et al.*, 2001) and have contributed to declining productivity in this system. Wheat is important cereal crop in eastern region of Nepal. Grain yield is a complex trait and depends on genetic factors and environmental influences. A successful selection depends upon the information on the genetic variability and association of morpho-agronomic traits with grain yield. The water logging situation in lowland during reproductive growth stage coupled with micronutrient deficiency was observed in Jhapa and Morang districts. Thus, we need to develop early maturing varieties like NL297 and RR21; which could address the high yield potential in spite of reproductive moisture stress, disease and hot westerly wind.

Materials and Methods

The genotypes were received from National Wheat Research Program (NWRP), Bhairahawa. The trial was conducted at Regional Agricultural Research Station (RARS) Tarahara during 2012 and 2013 wheat growing season with 100: 50: 25 kg NPK/ha of fertilizer dose. The varieties NL297, Gautam and RR21 were considered as check varieties because they are popularly grown in eastern region. Experimental farm of RARS Tarahara, 130 masl, was selected to carry out the trial. A total of twenty four wheat genotypes including checks were evaluated in alpha lattice design with two replications in both the years. Grain yield and its contributing parameters were recorded and analyzed to compare the genotypes using Genestat software.

Results

Meteorological observation

The average monthly temperature was highest in March i.e. 35^0C and rain fall in April, in the same way there was decline in rainfall after the month April which suggested that wheat genotypes get moisture stress in April and temperature stress during maturity in March. Some

susceptible wheat genotypes got enforced maturity by heat stress.

The analysis of variance revealed the significant variations were present in the genotypes for yield, heading days, maturity days, plant height, spikes -^{m2} and grains per spike. The genotypes BL3978 (69), NL1140 (74), BL3623 (74), NL1026 (74), BL 3594 (74) and BL3264 (74) required minimum number of heading days, even less than check variety NL297 (72). Among them, NL1140 and NL1026 were resistance to leaf rust, early in maturity, high number of grains per spikes and good yield.

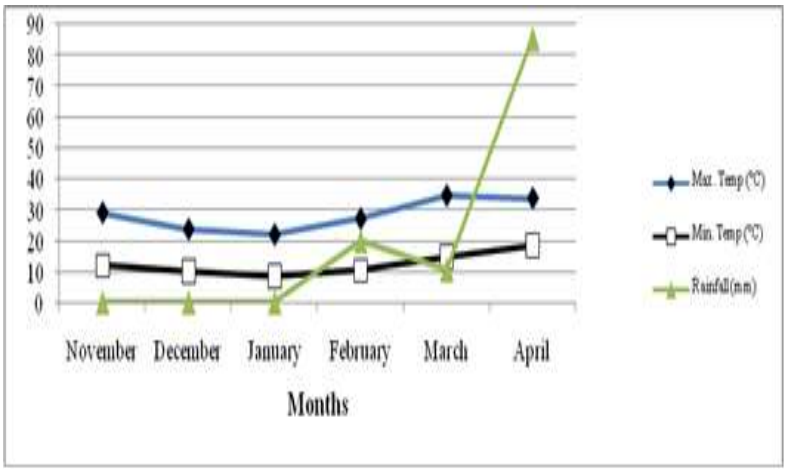

Fig. 1: Meteorological data of Regional Agricultural Research Station, Tarahara for the year 2012/13.

Table 1: Combined mean, yield, yield components and leaf rust severity of twenty four wheat genotypes at RARS Tarahara during the year 2011/12 and 2012/2013.

Genotypes	Yield (ton/ha)	Grains/spike	Plant height(cm)	Heading days	Maturity days	Panicle length(cm)	Spikes/m2	LR Severity
BL3978	3	28	91	69	97	10.5	269	MS
NL297	2.3	28	83	72	101	10.95	209	S
NL1140	2.3	32	89	74	107	9.3	272	R
BL3623	3.03	31	81	74	103	10.65	241	S
NL1026	2.8	29	91	74	102	9.9	193	R
BL3594	2.93	26	122	74	102	9.45	256	MS
BL3264	3.03	35	89	75	103	9.9	234	S
RR21	2.37	33	97	75	103	10.85	250	S
BL4343	2.6	32	92	75	108	7.4	164	S
BL3542	2.9	37	97	76	104	11.15	252	S
BL3528	2.8	34	92	76	104	10.85	208	S
BL3535	3.2	32	84	76	104	10.05	269	MR
BL2931	2.4	30	99	76	104	10.25	194	MR
BL4018	2.7	28	91	76	104	11.55	190	S
BL3471	2.5	31	87	77	105	10.5	217	R
NL1094	2.8	38	84	78	107	9.6	240	MR
Gautam	2.66	34	93	78	105	12	212	S
NL1093	1.86	39	90	79	103	10.6	205	S
BL3401	2.57	36	87	79	107	10.85	231	S
BL3539	2.6	31	93	79	107	10.85	224	S
NL1143	2	22	91	79	106	10	222	R
BL4012	2.7	32	81	80	107	10.8	251	S
NL1135	3	24	82	80	102	8.9	202	R
BL3404	2.38	22	75	80	108	9.5	220	R
CV%	23.5	22.1	5.8	3.3	2.1	7.2	15.3	
P value(G)	0.23	0.04	0.001	0.001	0.001	0.001	0.015	

S=Susceptible, R= Resistance, MR= Moderately resistance and MS= Moderately Susceptible.

Heritability and genetic gain

High broad sense heritability was found for the grains per spike (71.01%), plant height (93.58%), panicle length (78.48%) and yield (66.71%). Quantitative traits with high genetic gain and high heritability are important for the selection of genotype at early stages in breeding program (Dwivedi *et al*., 2002).The low broad sense heritability estimate indicated low genetic potentials for the traits under investigation, effect of environment in determining measured traits and absence of predominant role of additive gene action (Johnson *et al.*, 1955). Sachan & Singh (2003) also reported high heritability estimates for grain yield, number of spikelets per spike, number of seeds per spike, plant height, 100-seed weight and number of tillers per plant. The number of grains per spike and yield has good genetic gain and they may control through additive gene effects therefore selection may be effective in early generations for these traits. The combination of high heritability and genetic gains are important indicators of the predominant role of additive gene action in characters (Mondal, 1997). High heritability for spike length and plant height coupled with low genetic gain indicates non-additive gene effects for these traits. Therefore, there seems to be a limited scope of improvement while using these traits.

Correlation coefficient

Positive correlation coefficient had been found for the tillers per meter square with grains per spikes. The correlated traits like grains per spike and spikes per meter square would be the most useful traits that could be utilized in earlier selection criteria because they had positive correlation with yield (Table 3). Similarly, high genetic heritability coupled with high genetic gain was found for the spikes per meter square and grains per spikes (Table 2). The significant positive correlation of tillers per plant and ear length with yield per plant were reported by Mondal et al (1997) and that of number of grains per spike and number of spikelet's per spike by Sachan *et al.* (2003). The most stable yield producing genotypes over the years were BL3264, BL3535, BL3623, NL1135 and BL3978.

Variability study

The wheat genotypes were clustered into four different clusters based on the morpho-genic differences for the studied traits. The genotype BL3594 was observed in the different separate cluster. The genotype BL3594 had the highest plant height (122 cm) and showed moderately resistance to leaf rust. The genotypes BL3535, NL1140 and BL3978 were found in the separate cluster II, NL1094, BL3623, BL3401, BL3264, BL4012, BL3542 and RR-21 were grouped within the cluster III while BL4343 in cluster IV. The other remaining genotypes were in the cluster-I. These genotypes were separated within different clusters based on their morphological variability. The check genotypes Gautam and NL297 were found within cluster I these could be utilized in crop improvement program as a parent (Fig. 2).

Table 2: Heritability and genetic gain of the quantitative traits of wheat genotypes tested at RARS, Tarahara during 2012 and 2013 wheat growing season

Traits	Genotypic variance	Phenotypic variance	Heritability (h_{bs})	Genetic Gain(GG)
Grain Yield	0.493	0.74	66.71	44.61
Grains /spike	86.35	121.59	71.01	51.48
Plant height	322.6	344.73	93.58	39.76
Panicle length	2.07	2.6375	78.48	25.22
Spikes/m2	2584	5624	45.94	30.82

Table 3: .Correlation coefficient of the morphological traits of tested wheat genotypes at RARS Tarahara during 2011-2012

Traits	Yield	Grains/spikes	Plant height	Heading days	Maturity days	Panicle length	pikes/m2
Yield	1	0.048	0.04	-0.282	-0.308	-0.053	0.293
Grains/spike		1	0.02	0.034	0.142	0.262	0.129
Plant height			1	-0.296	-0.247	0.004	0.076
Heading days				1	.674**	0.025	-0.231
Maturity days					1	-0.217	-0.155
Panicle length						1	0.168
Spikes/m2							1

**= Significant at 1% level

Table 4: Characterization of wheat genotypes having higher number of grains per spikes tested at RARS Tarahara during 2012 and 2013 wheat growing season.

Genotypes	**Yield (ton/ha)**	**Grains/spike**	**Heading days**	**Spikes/m^2**	**LR Severity**
NL1093	1.86	39	79	205	**S**
NL1094	2.8	38	79	240	MR
BL3542	2.9	37	76	252	S
BL3401	2.57	36	79	231	**S**
BL3264	3.03	35	75	234	S

GAUTAM	2.66	34	78	212	S

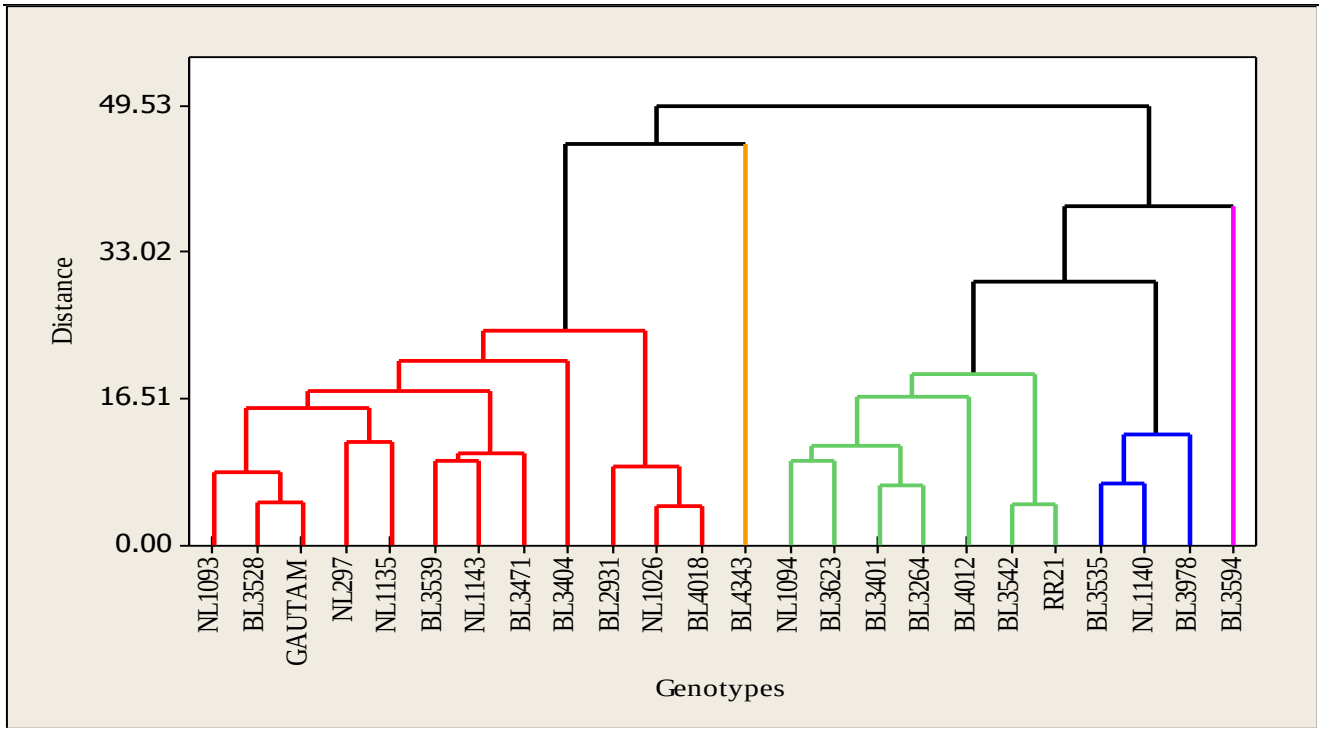

Fig. 2: The variability present in wheat genotypes shown in average Euclidian distance

Table 5: Characterization of wheat genotypes having higher number of spikes per meter square tested at RARS Tarahara during 2012 and 2013

Genotypes	Yield (ton/ha)	Grains/spike	Heading days	Spikes/m^2	Leaf Rust Severity
NL1140	2.3	32	74	272	R
BL3535	3.2	32	76	269	MR
BL3978	3	28	69	269	MS
BL3594	2.9	26	74	256	MS
BL3542	2.9	37	76	252	S
BL4012	2.7	32	80	251	S

Characterization of genotypes

The genotype NL1093 (39) had the highest number of grains per spike and could be used as the parents for hybridization program. However, NL1094 (38) could be directly recommended as variety for commercial cultivation. The genotype BL3542 produced higher yield (2.9 t/ha), more number of grains per spike (37) and high tillers per meter square (252). The genotype had medium duration of heading days (76) and seemed to be the best variety. Early maturing genotypes those could escape hot westerly wind and rainfalls during vegetative growth stages were BL3594, NL1026, BL3978 and NL1140.

Conclusion

The variety BL3978 had maturity duration of 97 days from the date of seeding even less than check variety NL297. The new varieties like BL3542, BL3978, BL3594 and NL1140 were considered as suitable varieties for all studied phenotypic traits to the eastern terai region of Nepal.

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