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VARIETAL IMPROVEMENT OF WHEAT UNDER RAINFED CONDITIONS IN MID-WESTERN TERAI OF NEPAL

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Abstract

Coordinated Varietal Trials (CVT) of wheat were planted under rainfed conditions at Regional Agriculture Research Station Khajura in winter season of 2011/12 and 2012/13 and Initial Evaluation Trials (IET) were planted in 2012/13. Trials were planted in Randomized Complete Block Design and recommended cultivation practices were followed. In CVT, combined analysis of genotypes over the years revealed significant differences in terms of days to heading, maturity days, grains per spike, grain yield and straw yield. Significantly highest grain yield was obtained in genotype NL1094 followed by Bhrikuti. Correlation coefficient showed that days to maturity had highly positive correlation with days to heading. Similarly; in IET, tested thirty genotypes showed significant difference for grain yield and genotype NL1193 revealed the highest yield followed by BL 4406. Correlation coefficient computation showed that days to maturity had positively highest and highly significant correlation with plant height.

Keywords: *Varietal trial, rainfed, genotypes, yield*

1. Introduction

Wheat (*Triticum aestivum* L.), also known as king of cereals, is primary among cereals and indeed among all crops, as direct source of food for human beings. Wheat ranks first both in the acreage and production of the world (UNDP and FAO, 2002). It ranks third important cereal crop (after rice and maize) in Nepal with production, productivity and area of 1882220 metric ton, 2477 kg/ha and 759843 hectare, respectively in 2012/13 (MoAD, 2014). Wheat contributes 7.14% of AGDP of the country (MoAC, 2011). With increasing world population, food security is projected to become more critical, increasing wheat yield potential remains a tall order in the developing world. The problem of drought is acute in developing countries of the world where about 37% of wheat growing areas are semi-arid in which available limited soil moisture constitutes a primary hurdle in way of wheat production. Drought is often coupled with moisture stress especially in rainfed areas which causes reduction in number of grains per spike and seed size and consequently significant reduction in grain yield. Drought is a situation of limited rainfall that is substantially below what has been established to be a "normal" value for the area concerned. It is a recurring climatic event and a global phenomenon but its features vary from region to region. Drought is said to occur when soil moisture is insufficient to meet crop water requirements, resulting in yield losses (Pandey and Bhandari, 2007). Crop response to moisture deficit also depends on the timing and intensity of drought. Most annual crops are highly sensitive to moisture deficits during flowering and grain formation. Even short periods of drought during these critical stages of crop growth can cause substantial production loss. Drought stress is characterized by reduction of water content, diminished leaf water potential and turgor loss, closure of stomata and decrease in cell enlargement and growth. Severe water stress may result in the arrest of photosynthesis, disturbance of metabolism and finally the death of plant (Jaleel et al., 2008). The correlation of yield attributing and quantitative traits with grain yield described the inter-relationship among them. It merely indicates the intensity of association.

Most of the Nepalese farming system is solely based on the rainfed and wheat cultivation is mainly depends on limited winter rain, but water scarcity and heat problems predominantly decrease the wheat production of terai, inner terai and hilly areas in Nepal and slows down the increase of wheat productivity. Varietal improvement in drought tolerance along with increase in production may be accomplished by selection under rainfed conditions. Therefore, there is urgent need to analyze and evaluate the new diverse combination of genes to develop the advanced drought and heat resistance/tolerance lines and cultivars suitable for the Nepalese farmers. In this light, this research is intended to identify superior wheat varieties for rainfed condition of mid-western terai region of Nepal.

2. Materials and Methods

Under rainfed condition, coordinated varietal trials (CVT) of wheat were sown at RARS Khajura, with coordination from National Wheat Research Program (NWRP), Bhairahawa in winter season of 2011/12 and 2012/13. The precise location of experimental site was 28006'N, 81037'E and at an altitude of 181 meters above sea level. The soil was sandy to silty loam with pH 7.2-7.5 and poor in organic carbon and available N but medium in available P2O5 and K2O. A set of twenty genotypes obtained from NWRP is planted as CVT in RCBD. The planting geometry was continuous sowing in row with row spacing of 25 cm and recommended cultivation practices were adopted. Fertilizer was applied at the rate of 60:30:20 NPK kg/ha. Among cultivated genotypes, ten superior genotypes and checks repeated in two years' trial were used for combined analysis. These genotypes include NL 1093, NL 1097, NL 1094, BL 3978, NL 1143, NL 1135, Bhrikuti, Gautam, RR 21 and NL 1140. Similarly; in initial evaluation trial (IET) in 2012/13, 30 wheat genotypes were planted in RCBD design with recommended cultivation practices. In both cases; various phenological, morphological and yield attributing traits such as days to heading, days to maturity, plant height (cm), grains per spike, thousand kernels weight (gm), grain yield (kg/ha) and straw yield (kg/ha) were recorded. Different software and computer programs; MSTAT, SPSS, CROPSTAT 7.2 and MS-Excel were applied for detail data analysis and correlation computation. During the experiment period, the rainfall data was also recorded and variation in rainfall pattern over the years is graphically presented in Fig. 1.

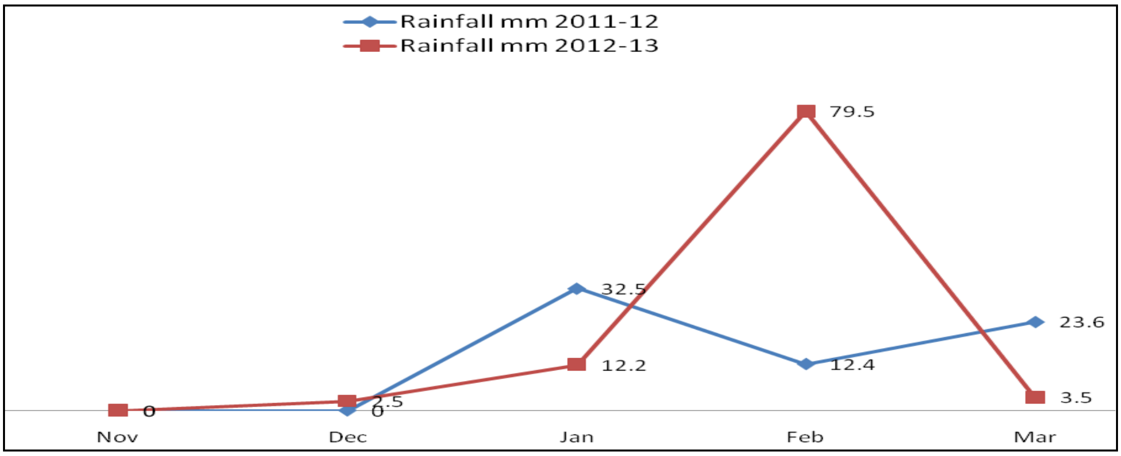

Fig 1: Graph showing monthly rainfall pattern during wheat season in 2011/12 and 2012/13

3. Results and Discussion

3.1 Yield attributes and yield traits for CVT

In case of CVT trial,; combined analysis of genotypes over the years revealed significant differences in terms of days to heading, maturity days, grain number per spike, grain yield and straw yield. Among the tested entries, genotype BL 3978 had earliest heading (83 days) followed by RR21 (86 days). In contrast, genotype NL 1135 had most delayed heading (93 days) followed by genotypes NL 1094 and NL 1097 (92 days) at par. Genotype BL 3978 had earliest maturity (117.5 days) followed by RR21 (118 days). In contrast, genotype NL 1135 recorded the latest maturity (123 days) followed by NL 1097 (121 days). Genotype NL 1093 has highest no. of grain per spike (37) followed by NL 1094 (37) and the least was obtained in RR21 (30) followed by NL 1135 (30). Genotypes did not show significant differences in terms of plant height and thousand kernels weight and plant height. On combine analysis, Gautam was found to be tallest (90 cm) and the maximum thousand kernels weight was obtained in genotype BL 3978 (44 gm). Detail of the combined analysis of result regarding different yield attributing traits is presented in Table 1.

Similarly, significantly highest grain yield was obtained in genotype NL1094 (2538 kg/ha) followed by Bhrikuti (2483 kg/ha) and NL 1093 (2292 kg/ha) respectively. In contrast, lowest grain yield was recorded in genotype RR21 (1585 kg/ha) followed by NL 1097 (1942 kg/ha). Straw yield was found highest in genotype NL 1094 (2749 kg/ha) followed by Bhrikuti (2672 kg/ha) and least in RR21 (2015 kg/ha). Variety NL 1094 is reported to be promising in preliminary experiments of NWRP in RARS Nepalgunj as well as other locations. Detail of the combine analysis of result regarding yield traits is presented in Table 1 and Fig 2.

Table 1: Combine analysis of yield attributes of Rainfed CVT

Genotypes	Days to heading	Days to maturity	Plant height	No. of grains per Spike	Thousand kernel wt (gm)	Grain yield (kg/ha)	Straw yield (kg/ha)
NL 1093	90.75 AB	120.3 BCD	89.00	37.20 A	37.33	2292 ABC	2578 AB
NL 1094	91.75 A	119.0 DEF	80.44	36.95 A	34.11	2538 A	2749 A
NL 1097	91.75 A	121.0 AB	87.75	31.55 BC	36.17	1942 D	2129 C

BL 3978	82.50 E	117.5 F	87.25	33.10 ABC	44.19	2161 CD	2470 AB
NL 1135	93.25 A	122.5 A	84.94	30.40 C	37.86	2178 CD	2398 B
NL 1140	87.25 CD	119.3 CDE	77.56	34.00 ABC	39.74	2218 BCD	2452 AB
NL 1143	88.50 BC	119.5 BCDE	84.81	34.25 ABC	34.23	2132 CD	2655 AB
Gautam	88.75 BC	120.8 BC	90.06	31.60 BC	40.71	2281 ABC	2464 AB
Bhrikuti	88.50 BC	118.8 DEF	82.56	35.95 AB	35.69	2483 AB	2672 AB
RR 21	85.75 D	118.0 EF	88.50	30.35 C	38.66	1585 E	2015 C
GM	88.875	119.65	85.287	33.535	37.869	2181.031	2458.18
CV	1.77%	0.87%	6.90%	7.99%	7.16%	8.15%	7.27%
LSD	2.334	1.541		3.966		263.2	264.6
F-test	**	**	NS	*	NS	**	*

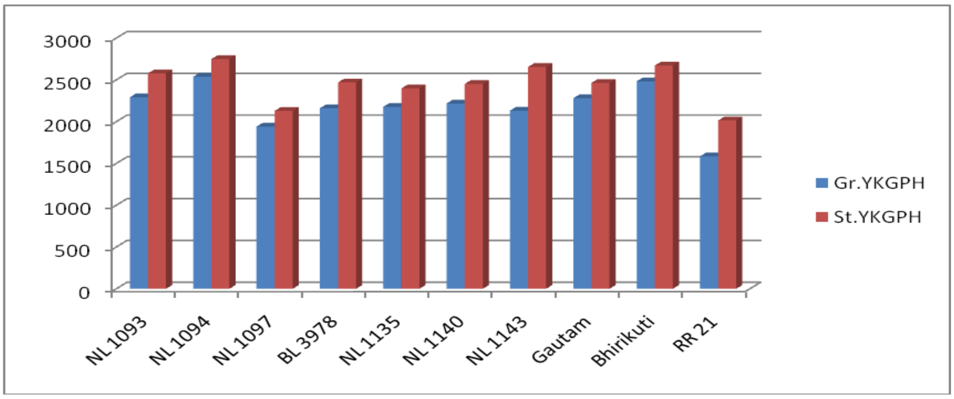

Fig 2: Graph showing mean value of yield traits of Rainfed CVT

3.2 Correlation analysis of CVT

For rational improvement of yield and its components, the understanding of correlation is very useful. A positive value of correlation shows that the changes of two variables are in the same direction, i.e. high values of one variable are associated with high values of other and vice versa. Correlation analysis was conducted among yield and yield attributes of rainfed CVT wheat over two years. Based on correlation coefficient, days to maturity had highest positive correlation (0.834**) with days to heading. Grain yield has positive correlation with plant height (0.215), number of grains per spike (0.304) and thousand kernels weight (0.100). In contrast, highly negative correlation of grain yield was obtained with days to maturity (-0.489**) and days to heading (-0.439**). The detail correlation coefficients among recorded traits are shown in Table 2.

Table 2: Correlation analysis of yield attributing and yield traits

Traits	Days to heading	Days to maturity	Plant height	No. of grains per Spike	Thousand kernels wt	Grain yield	Straw yield
Days to heading	1						
Days to maturity	0.834**	1					
Plant height	0.016	0.093	1				
No. of grains per spike	0.087	-0.126	0.041	1			
Thousand kernel wt	-0.085	0.070	-0.062	0.106	1		
Grain yield	-0.439**	-0.489**	0.215	0.304	0.100	1	
Straw yield	0.244	0.208	0.329*	0.342*	0.127	0.283	1

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

3.3 Yield attributes and yield traits for IET

In IET rainfed trial 2012/13, tested thirty genotypes showed very high significant differences in terms of days to heading, maturity days, plant height, grains per spike and thousand kernels weight. Genoypes BL 4411, NL 1187 and NL 1197 had longest days to heading (100 days) whereas genotype NL 1193 reveled shortest days to heading (84 days). Genotype NL 1187 showed longest days to maturity (125 days) followed by BL 4411 and BL 4461 (124 days). Among the tested entries, BL 4441 was found to be tallest and genotype NL 1186 was the dwarfest genotype. Average number of grains per spike was found highest in BL 4421 (39) followed by BL 4458 (39). In contrast, genotype BL 4441 had lowest number of grains per spike (31). Thousand kernels weight was found maximum for genotype BL 4458 (45.3 gm) followed by BL 4411 (44.2 gm). In contrast, genotype NL 1187 had the least thousand kernels weight. The difference was significant in case of grain yield and genotype NL 1193 (3428 kg/ha) followed by BL 4406 (3106 kg/ha) revealed the highest yield. In contrast, genotype NL 1186 (1645 kg/ha) had the lowest grain yield among tested genotypes under rainfed conditions in 2012/13. Detail of result regarding different yield attributing and yield traits has been presented in Table 3.

Table 3: Statistics of yield attributes and yield traits of Rainfed IET

Genotypes	Days to heading	Days to maturity	Plant height	No. of grains per spike	Thousand kernel wt (gm)	Grain yield (kg/ha)
BL 4406	86	119	93.375	36.4	42.39	3106.25
BL 4407	87	118	91.25	32.7	39.35	2805
BL 4410	90.5	119	96.125	32.4	42.645	2598.75
BL 4411	100	123.5	99.625	34.1	44.195	2197.5
BL 4416	91.5	119.5	89.75	35.9	41.315	2680
BL 4421	87.5	118.5	89.625	38.9	41.27	2086.25
BL 4424	87.5	119	93	38.3	41.745	2273.75
BL 4433	93	122.5	98.625	35.3	43.15	2236.25
BL 4435	93	121.5	93.25	34.3	42.11	2672.5
BL 4441	94	121	110	30.9	42.235	2430
BL 4448	90.5	118.5	86.25	32.8	34.975	2175
BL 4450	99	120	87.625	34.1	42.53	1810
BL 4458	94	118.5	86.5	38.5	45.335	2256.25
BL 4461	91.5	123.5	91.875	37.5	42.795	2387.5
BL 4463	90.5	123	89.875	35.4	43.395	2268.75
BL 4464	91.5	122	91.375	34.9	40.92	2055
NL 1186	97.5	117	78.375	35.6	36.325	1645
NL 1187	100	124.5	88.375	31.6	32.68	2718.75
NL 1188	89	118	86.5	37.5	40.17	2308.75
NL 1189	87.5	119.5	88.625	38.2	40.02	2082.5
NL 1190	88	117	83.125	34.9	40.445	2153.75
NL 1191	85	119	81.875	35.3	39.35	2115
NL 1192	85	119	84.5	35	42.5	2495
NL 1193	83.5	119	86.75	37.4	41.45	3427.5
NL 1194	97.5	117	83.5	37.6	34.37	1671.25
NL 1195	94	119.5	87.625	36.5	38.485	2406.25
NL 1196	92.5	118.5	79.625	36.8	35.615	1931.25
NL 1197	100	123	82.75	36.2	42.775	2088.75
Gautam	91.5	123	90.5	32.4	42.395	2216.25
Bhrikuti	89.5	119.5	80.625	35	36.89	2506.25
5% LSD	5.24973	1.62684	7.16184	3.17191	5.79639	785.462
G Mean	91.583	120.02	89.029	35.413	40.461	2326.8
CV	2.8	0.7	3.9	4.4	7	16.5
F-test	**	**	**	**	**	*

3.4 Correlation Analysis of IET

Correlation measures the degree and direction of association between two or more variables. Correlation analysis was conducted among yield and yield attributes of rainfed IET wheat. Based on correlation coefficient, days to maturity had positively highest and highly significant correlation (0.403**) with plant height. Grain yield has positive correlation with days to maturity (0.121), plant height (0.229) and thousand kernel weight (0.077). In contrast, negative coorelation of grain yield was obtained with days to heading (-0.305*) and number of grains per spike (-0.088). The least correlation value was obtained between number of grains per spike and plant height (-0.330*). The detail correlation coefficients among recorded traits are shown in Table 4.

Table 4: Correlation analysis of yield attributing and yield traits in IET rainfed Wheat

	Days to heading	Days to maturity	Plant height	No. of grains per spike	Thousand kernel wt (gm)	Grain yield
Days to heading	1					
Days to maturity	0.395**	1				
Plant height	0.059	0.403**	1			
No. of Grains per spike	-0.206	-0.276*	-0.330*	1		
Thousand kernel wt	-0.137	0.195	0.304*	0.053	1	
Grain yield	-0.305*	0.121	0.229	-0.088	0.077	1

**. Correlation is significant at the 0.01 level (2-tailed). *. Correlation is significant at the 0.05 level (2-tailed).

4. Conclusion

Varietal evaluation of improved wheat genotypes under rainfed condition was conducted through these trails. Promising wheat genotypes for rainfed condition identified from these researches are NL1094, Bhrikuti, NL 1093, NL1193 and BL 4406. This research paper presents possibility of extension of these new promising genotypes in rainfed areas of western terai region. The present scenario of the grain scarcity, increasing trend of population growth and increasing climate change is forcing to intensify the wheat production. To address these issues in drought prone western terai region of Nepal; similar researches need to be emphasized in days to come.

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References

Afifi, A. A. and V. Clark. (1984). Path analysis. *In*: computer-aided multivariate analysis. Lifetime Learning Publ., Belmont, CA. pp. 235-237.

Dewey, D. and K. H. Lu. (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. Agronomy Journal 51:515-518.

Jaleel, C. A., P. Manivannan, G. M .A. Lakshmanan, M. Gomathinayagam and R. Panneerselvam. (2008). Alterations in morphological parameters and photosynthetic pigment responses of *Catharanthusroseus* under soil water deficits. Colloids Surf. B: Biointerfaces 61:298–303.

MoAC. (2011). Selected indicators of Nepalese agriculture and population. Government of Nepal, Ministry of agriculture and Co-operatives, Gender Equity and Environment Division, Singh Durbar, Kathmandu, Nepal. 120 p.

MoAD. (2014). Statistical information on Nepalese agriculture 2012-13. Government of Nepal, Ministry of Agriculture Development. Agribusiness Promotion and Statistics Division, Singh Durbar, Kathmandu, Nepal. Tridevi Chhapakhana, Bagdol, Lalitpur, Nepal.

Pandey, S. and H. Bhandari. (2007). Drought: an overview. *In*: S. Pandey, H. Bhandari and B. Hardy (eds.) Economic costs of drought and rice farmers' coping mechanisms: a cross-country comparative analysis. International Rice Research Institute. Los Baños, Philippines.

Pandey, S., H. Bhandari, R. Sharan, S. Ding, P. Prapertchob, D. Naik and K. S. Taunk. (2005). Coping with drought in agriculture of developing countries: insights from rice farming in Asia. *In*: Proceedings of the 2nd International Conference on Integrated Approaches to Sustain and Improve Plant Production under Drought Stress, 24–28 September. 2004, University of Rome, ''La Sapienza'', Rome, Italy. pp. 125-133.

UNDP and FAO. (2002). Land resources appraisal of Bangladesh for agricultural development. Report on agroecological regions of Bangladesh. United Nations Development Programme and Food and Agriculture Organization. pp. 212-221.

Wright, S. (1921). Correlation and causation. Journal of Agricultural Research 20: 557-585.