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Analysis of Yield Attributing Characters of Different Genotypes of Wheat in Rupandehi, Nepal

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Abstract— *Field experiment was conducted at National Wheat Research Program, Bhairahawa, Rupandehi with the objective to identify high yielding superior wheat genotypes for Rupandehi district of Nepal during 2014. Experiment was laid out in one factorial Randomized completely block design with ten wheat genotypes including both released and promising; Annapurna 1, Annapurna 3, Pasang Lahmu, Bijaya, BL 3623, Bhirkuti, NL 297, BL 4316, BL 3978 and BL 4347 with three replications. The results showed that the grain yield of BL 3978 was found higher (4.03 t ha^{-1}) than other genotypes followed by BL 4347 (3.93t ha^{-1}). BL 3978 have also higher number of effective tillers m^{-2} and test weight. Among release varieties, NL 297 show higher yield (4 t ha^{-1}) followed by Bhirkuti (3.43 t ha^{-1}) and Bijaya (3.37 t ha^{-1}). From this experiment it can be concluded that BL 3978 was found promising among all genotypes however should be tested at on-farms before promoted for general cultivation in Rupandehi district of Nepal.*

Keywords- Genotypes, Wheat, Yield.

I. INTRODUCTION

Agriculture contributes on an average 33 percent to Gross Domestic Product and employs 65.7 percent of the labor force in Nepal [1]. Wheat is the third most important crop after rice and maize, but in terms of human consumption it ranks second. Wheat is grown in different agro-ecological zones and environments with different production potentials. It is cultivated on 745,823 hectares of land and has the production of 1,736,849 tones with average productivity of 2.32 ton hac^{-1} in Nepal [2]. Cereals crop share about 37 % to agricultural GDP, among this wheat share about 7.14 % [3]. It occupies 24% of total cereal area and contributes 20% of the total cereal production in Nepal [2]. Most of the wheat area (57.8%) and production (65.2%) occurred in terai region which occupy only 23% of the total land area of Nepal [2]. Improved varieties cover about 95.8% of the total wheat area whereas, 66.21% of total wheat crop area is grown under irrigated environment [2].

National Wheat Development Programme was established in 1972 to organize the research and development works on wheat as a commodity crop. Since then, there have been great achievements brought out by the consolidated efforts of wheat researchers, extension workers and farmers. So far there are 35 improved wheat cultivars and 90% of the wheat area is covered by modern wheat cultivars in Nepal [4]. Nepal Agriculture Research Council [5] mentioned that performance in wheat production in Nepal has increased remarkably due to wide spread cultivation of high yielding varieties since 1972. In fact Department of Agriculture had launched a “Grow More Wheat Campaign” in 1965/66 with the introduction of Mexican wheat varieties introduced via India. The new varieties of seed were launched since then and now occupy 96% in 2006/2007 [6]. There are altogether 30 varieties developed for different environment in Nepal [7]. During the last 38 years period from 1970/71 to 2007/08 the production of wheat in the Terai region increased from 81,600 Mt to 1,040,535 Mt [8]. One of the reasons for increase in wheat yield is the use of improved seeds. About 97% of seeds used in Nepal during 2007/ 2008 [9] was improved. With availability of the high yielding varieties as well as improved irrigation facilities in terai, wheat yield has increased more than three times in the terai. The low productivity of wheat in Nepal is mainly due to three reasons; low yielding varieties, low use of production inputs like seeds, fertilizer etc, and lack of irrigation and poor soil fertility management practices [10].

Therefore this study was conducted at National Wheat Research Program Bhairahawa, Rupandehi, Nepal in 2014/15 during winter seasons in order to identify high yielding superior wheat genotypes for Rupandehi district of Nepal.

II. MATERIALS AND METHODS

Location, Climate and Weather Condition

A field experiment was conducted at NWRP (National Wheat Research Program) farm, Bhairahawa, Rupandehi which is located in the south part of Rupandehi and near the India border (Figure 1). This area is located at latitude 27° 30' 0" N and longitude 83° 27' 0" E. Weather and climate of this area is around 40^0C in summer season and 10^0C in winter season. Average Monthly Rainfall: 545.6 mm.

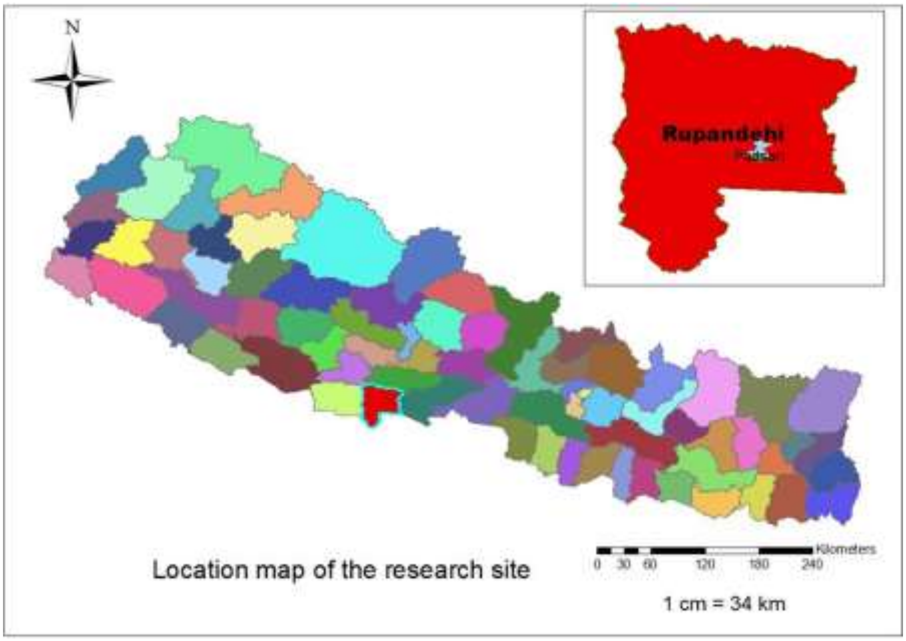

Fig.1: Map of Rupandehi district sowing research site (NWRP, Bhairahawa)

Design of the experimental plot and sowing

The experimental plots were laid out in one factor RCB design consisted of 10 wheat genotypes (Annapurna 1, Annapurna 3, Pasang Lahmu, Bijaya, BL 3623, Bhirkuti, NL 297, BL 4316, BL 3978 and BL 4347) with three replications. Each replication was separated by 2m tally, while the plot was separated by 1m. The size of the individual plot was 3m × 2m i.e. 6 m^2. Spacing between row to row was 25 cm and plant to plant is continuous, there was 12 rows of 2 m long. All wheat genotypes were sown on same date of 15 December of 2013 with seed rate of 120 kg ha^{-1}. Chemical fertilizer was applied @ 100:50:25 kg $N:P_2O_5:K_20$ kg ha^{-1}.Half dose of nitrogen, full dose of phosphorus (50 kg ha^{-1}) and potash (25 kg ha^{-1}) were applied as basal dose. Remaining half dose of nitrogen fertilizer was applied as top dress in two-split doses i.e. $1/4^{th}$ at CRI stage after first irrigation and $1/4^{th}$ at panicle initiation stage. Data collection based on plant height, spike length, effective tillers m-2, number of grains per spike, grain yield t ha-1, biomass yield t ha-1, harvest index and test weight. Statistical analysis was done using Microsoft Office Excel, and MSTAT-C Package program.

III. RESULTS AND DISCUSSION

Biometrical observation

Plant height

Result revealed that plant height was highly significantly influenced by different genotypes. Plant height was observed maximum on Pasang variety (111.1cm). Whereas minimum plant height was recorded on Bhirkuti (66.87 cm). Which was at par with BL 3623 (73.4 cm) (Table 1). The minimum plant height was due to varietal characters, lack of proper irrigation at CRI stage and soil condition. These results were in line with [11] who reported that the plant height was significantly different between genotypes.

Spike length

Spike length was highly significantly influenced by the different genotypes of wheat (Table 1). BL 3978 have more in length (11.47 cm) and it was at par with NL 297 (11.27 cm) and Pasang (11.2 cm). And the shortest spike length was observed in Bijaya (8.06 cm). Which was at par with Annapurna 1 (8.46 cm) (Table 1). These results were in line with [11] who reported that the spike length was significantly different between genotypes.

Effect of genotypes on yield attributing traits of wheat

Effective tillers per square meter

Among yield attributing components, productive tillers are very important because the final yield is mainly a function of the number tillers bearing spike per unit area. The effective tillers m^{-2} was highly influences by different genotypes significantly (Table 1). An average effective tiller m^{-2} was recorded in the experiment was 217.

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Among cultivars, BL 3978 showed higher effective tillers m^{-2} (285) (Table 1), which was followed by BL 4347 (270). Whereas lower effective tillers was given by Pasang (179), which was at par with Annapurna 1 (182) and BL 3623 (189). Significant difference in effective tillers among the cultivars might be due to their genotypic characteristic. These results were in line with [11] who reported that the productive tiller was significantly different between genotypes. Our finding was also confirmed by [12].

Number of total grains per spike

Genotypes highly influenced the number of grains per spike significantly (Table 1). The average number of grains per panicle was found 40. Higher number of grains $spike^{-1}$ was found in Annapurna 1 (52) followed by Bhirkuti (46). Lowest number of grains $spike^{-1}$ was found in BL 4316 (30) followed by BL 4347 (32) (Table 1). These results were in line with [11] who reported that the number of total grains per spike was significantly different between genotypes. Quite identical results were obtained by [13, 14, 15 and 16].

Thousand grains weight (Test weight)

Effect of genotype on thousand grains weight was highly significant (Table 1). Comparatively higher test weight was found in BL 3623 (40.7 g) followed by Bijaya (40.1 g). Annapurna 3 has minimum test weight (29.1 g) followed by Pasang (29.2 g) (Table 1). Higher test weight was found due to varietal characters as well as sufficient moisture during the growing period. [17] Also found that test weight was significantly influenced by the genotypes.

Table.1: Effect of genotypes on grain yield, biomass yield and harvest index of wheat at National Wheat Research Program, Bhairahawa, Rupandehi, 2014

Genotypes	Plant height (cm)	Spike length (cm)	Effective tillers m^{-2}	Total grains $spike^{-1}$	Test weight (g)
Annapurna 1	74.4^{cd}	8.467^{de}	182^{d}	52^{a}	32^{de}
Annapurna 3	81^{bc}	8.667^{d}	200^{bcd}	41^{bcd}	29.1^{e}
Pasang	111.1^{a}	11.2^{a}	179^{d}	35^{cdef}	29.2^{e}
Bijaya	82.87^{b}	8.067^{e}	222^{b}	42^{bc}	40.1^{a}
BL 3623	$73.4d^{e}$	8.8^{d}	189^{cd}	44^{b}	40.7^{a}
Bhirkuti	66.87^{e}	8.933^{cd}	222^{b}	46^{ab}	35.1^{cd}
NL 297	74.07^{cd}	11.27^{a}	213^{bc}	34^{def}	36.03^{bc}
BL 4316	75.47^{cd}	10.0^{b}	209^{bc}	30^{f}	39.3^{ab}
BL 3978	85.73^{b}	11.47^{a}	285^{a}	39^{bcde}	37.9^{ab}
BL 4347	78.73^{bcd}	9.333^{c}	270^{a}	32^{ef}	31^{e}
F test	**	**	**	**	**
SEM	2.21	0.1643	8.347	2.293	1.05
LSD (0.05)	6.565	0.4882	24	6	3.129
Grand mean	80.36	9.6	217	40	35.07
CV (%)	4.76	2.95	6.65	10.04	5.2

Means followed by the common letter (s) within each column are not significantly different among each other based on DMRT at 5% level of significance. F: test: ** denotes highly significance at 1 % level

Effect of genotypes on yield and harvest index

Grain yield

Grain yield is determined by the yield attributing traits of the crop. The yield of the particular crop in a location is a combined effect of genetic makeup of the cultivar, growing environment and the crop management practices. Grain yield is a function of yield attributing traits, primarily productive tillers, numbers of grains per spike and thousand grains weight etc.

Grain yield was highly significantly influence by the genotypes (Table 2). Higher grains yield t ha^{-1} was obtain in BL 3978 (4.03 t ha^{-1}) followed by NL 297 (4.0 t ha^{-1}) and BL 4347 (3.93 t ha^{-1}) (Table 2). Lowest yield was observed in Annapurna 3 (2.33 t ha^{-1}) followed by the Annapurna 1 (2.77 t ha^{-1}) and Pasang (2.80 t ha^{-1}) (Table 2). Low yield was found in these varieties due to their genotypic characters because they were recommended variety for hilly region; they show low performance in terai region.

[18] also found that grain yield was significantly influence by the genotypes. He also found that Gautam produced significantly higher yield than Bhrikuti and BL1473 under both the tillage practices. However,

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Bhrikuti also produced significantly higher grain yield than BL1473 under conventional tillage.

Biomass yield

Biomass yield was found to be highly significantly influenced among all genotypes (Table 2). Maximum biomass yield was observed in Bhirkuti and BL 3978 (8.3 t ha^{-1}) followed by BL 4347 (8.13 t ha^{-1}) (Table 2). Low biomass yield was found in BL 3623 (4.83 t ha^{-1}). Low biomass was due to the low straw yield in BL 3623 (1.23 t ha^{-1}) but have higher grain yield (3.6 t ha^{-1}) (Table 2). [18] supported our above results for biomass yield, which was significantly influenced by different genotypes.

Harvest index

Harvest index was found to be highly significantly influenced among all genotypes (Table 2). Maximum Harvest index was observed in BL 3623 (0.74) (Table 2). Whereas low Harvest index was observed in Annapurna 3 (0.33) followed by Annapurna 1 (0.37). Low harvest index was due to these variety was recommended to hilly region; they show low performance in terai region. [12] also found that harvest index was significantly differs in all genotypes.

Table.2: Effect of genotypes on grain yield, biomass yield and harvest index of wheat at National Wheat Research Program, Bhairahawa, Rupandehi, 2014

Genotypes	Grain yield (t ha^{-1})	Biomass yield (t ha^{-1})	Harvest index (HI)
Annapurna 1	2.77^{c}	7.3^{de}	0.37^{i}
Annapurna 3	2.33^{d}	7.06^{def}	0.33^{j}
Pasang	2.80^{c}	6.7^{f}	0.41^{g}
Bijaya	3.43^{b}	7.8^{bc}	0.43^{f}
BL 3623	3.60^{b}	4.83^{g}	0.74^{a}
Bhirkuti	3.37^{b}	8.3^{a}	0.40^{h}
NL 297	4.0^{a}	7.5^{cd}	0.53^{c}
BL 4316	3.50^{b}	6.83^{ef}	0.54^{b}
BL 3978	4.03^{a}	8.3^{a}	0.47^{e}
BL 4347	3.93^{a}	8.13^{ab}	0.48^{d}
F test	**	**	**
SEM	0.089	0.15	0.0057
LSD (0.05)	0.266	0.447	0.0017
Grand mean	3.38	7.27	0.46
CV (%)	4.59	4.58	4.51

Means followed by the common letter (s) within each column are not significantly different among each other based on DMRT at 5% level of significance. F: test: ** denotes highly significance at 1 % level

Correlation regression studies

To assess the relationship between growth parameters, yield attributing traits and grain yield simple correlation coefficients were worked out. The number of effective tillers m^{-2} contribute approximately 44.8 % (R^2 = 0.488) on the grain yield. Whereas the remaining 55 % increase in grain yield may be due to other variables (Figure 2). Similarly, approximately 26 % (R^2 = 0.26) contribution by test weight on the grain yield and the left 74 % increase in the grain yield by the other variables except test weight (Figure 3). Whereas grain yield contributed about 36 % (R^2 = 36) towards increase in the harvest index (Figure 4). And the remaining 64% increase in the harvest index by the other variables rather than harvest index.

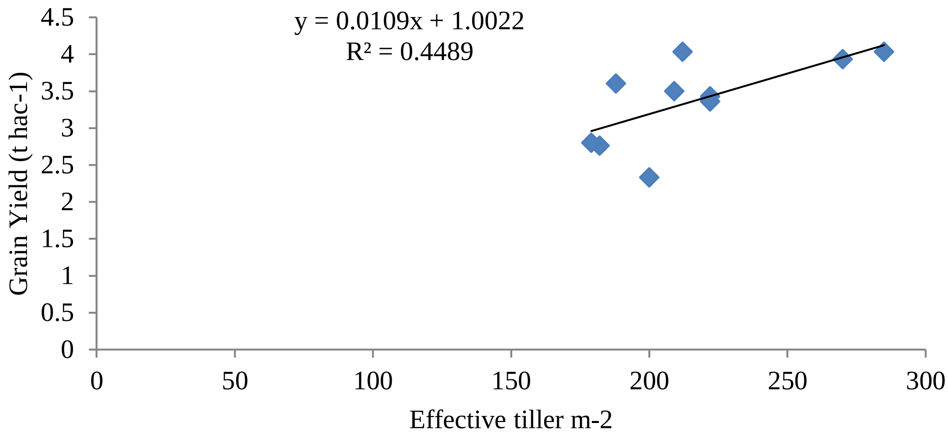

Fig.2: Relationship between grain yield and number of effective tillers per square meter of wheat at NWRP (Bhairahawa), Rupandehi, 2014

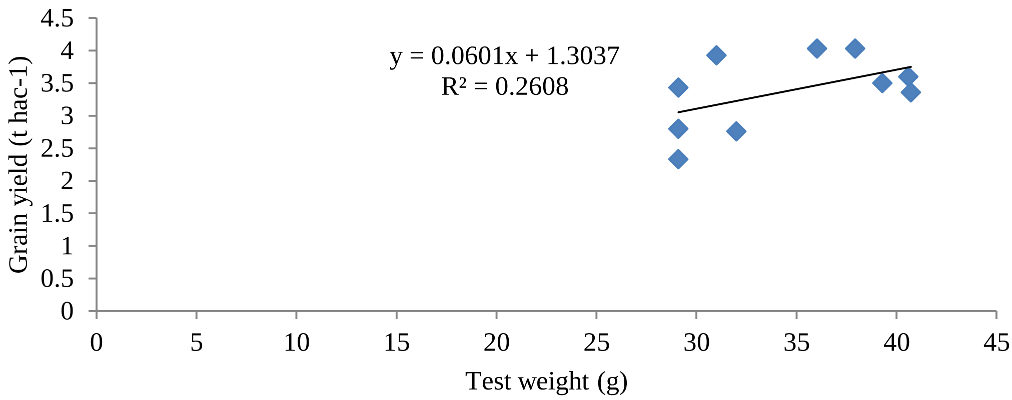

Fig.3: Relationship between grain yield and test weight (g) of wheat at NWRP Bhairahawa, Rupandehi, 2014

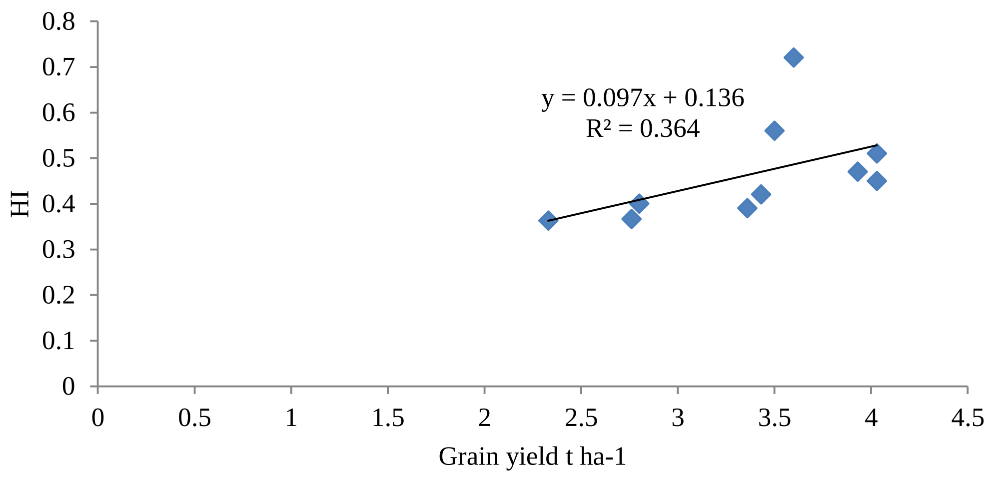

Fig.4: Relationship between grain yield and harvest index of wheat at NWRP Bhairahawa, Rupandehi, 2014

IV. CONCLUSION

The grain yield of BL 3978 was found higher than other genotypes followed by BL 4347. BL 3978 have also higher number of effective tillers m^{-2} also have higher test weight. Higher biomass yield also found in the BL 3978. Among release varieties NL 297 show higher yield followed by Bhirkuti and Bijaya. Bhirkuti show higher number of effective tillers m^{-2}. Grain per spike also found higher in Bhirkuti and Bijaya. From our experiment we concluded that BL 3978 is higher yielder among all genotypes and NL 297 and Bhirkuti is found to high yielding varieties. However, at least three years of multi-location experiment will be needed to validate this research further.

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