Research Article

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Effect of Different Wheat Variety and Sowing Methods on Grain Yield of Wheat under Bhairahawa Condition of Nepal

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ABSTRACT

A field experiment was conducted during winter seasons of 2016/17 and 2017/18 at National Wheat Research Program, Bhairahawa, Rupandehi, Nepal with the objective to study the different sowing methods in wheat. Variety comprises of Vijay and Bandganga were allocated in main plot whereas three sowing methods System of wheat intensification (SWI) at 20 cm × 20 cm, Line sowing at 25 cm × continuous and broadcasting were allocated in sub-plot under split plot design with four replications. Bandganga variety gave higher grain yield as compared to Vijay variety. SWI at 20 cm × 20 cm recorded significantly higher tillers (267 and 251 $m^{-2)}$ as compared to line sowing at 25 cm and broadcasting during both the years. SWI at 20 cm × 20 cm spacing recorded significantly higher grain yield (3739 and 3840 kg/ha) during 2016/17 and 2017/18, respectively. But it was found at par with line sowing at 25 cm x continuous method. Economic analysis of different sowing methods showed that both line sowing and SWI were found superior over broadcasting method. Highest Net returns of NPR 72,294 and 62,644 and B: C ratio (1.75 and 1.43) was obtained from line sowing and SWI methods respectively. Thus, SWI at 20 cm × 20 cm and line sowing method could be a better production technology to enhance the wheat productivity if mechanization is done to replace the required labor.

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Introduction

Wheat (*Triticum aestivum* L.) is grown across a wide range of environments around the world and has the highest adaptation among all the crop species. Wheat is rich source of protein, minerals and vitamins amongst all the cereals. It contributes about 60 percent of daily protein requirement and more calories to World human diet than any other food crops. It is the second most important crop after rice in Terai, Nepal, serving as one of the major staples in the diet eaten in the form of bread. There has been stagnation in wheat productivity since 2002 in Nepal. The current national average wheat yield is 2.50 t/ha [1]. The causes of low productivity is governed by many biotic and abiotic factors like,

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weather (low and high temperature stress, high RH and drought), lack of suitable high yielding genotypes for specific production domain; poor performance of existing cropping system and technologies of production being followed. Number of genetic and external factors controls the ultimate yield of wheat crop. An optimum level of single factor will not cause any appreciable increase in the yield itself, but a combination of factors contributes to the ultimate yield of wheat. It is well recognized that by keeping proper row spacing and input like seed treatment, fertilizer and seed rate etc. have an effective role in increasing the yield of crops. Wheat is generally planted by broadcast method by most of the farmers in Nepal, only progressive farmers and research scientists use line sowing. Now a day due to infestation of weeds, labor scarcity and partial mechanization in Nepal, line sowing is being practiced with proper row spacing, which besides facilitating inter-culture and convenient herbicide application for effective and effective weed control; help in intercropping and reducing the seed rate per hector without any adverse effect on the final grain yield.

The increasing demand for food necessitates further intensification of the crop productivity systems. The System of wheat intensification (SWI), based on low-tech methods, may be more labor-intensive than traditional techniques, but it requires less seeds, water, pesticide and fertilizer. Yield obtained in SWI is double than that of obtained conventional methods [2]. SWI techniques by utilizing minimum inputs and low seed rate coupled with efficient water saving (30 %) could address the problem of low productivity [3]. Therefore, this study was carried out to increase farmers' income by increasing production per unit area through the development of most profitable and productive technology in western region of Nepal.

Material and Methods

An experiment was conducted during winter seasons of 20167/17 and 2017/18 at the farm of National Wheat Research Program, Bhairahawa, Nepal. The climate of experimental site was sub-tropical with elevation of 105 masl, where maximum temperature goes up to 44.6 ^{O}C. The experiment was laid out in split plot design including variety viz; Vijay and Banganga as main plot and different sowing methods viz; broadcasting, line sowing (25 cm × continuous line sowing) and system of wheat intensification (SWI) at 20 cm × 20 cm as sub plot factor with four replication. Under SWI, two seeds per hill were sown at 20 cm × 20 cm spacing while in broadcasting at

150 kg/ha (farmers practice) and line sowing at 120 kg/ha seed rate was applied. Fertilizer was applied at 150:50:50 N_2:P_2O_5:K_2O for line sowing and 100: 25: 20 N_2:P_2O_5:K_2O kg/ha for broadcasting. Other intercultural operations were done as per recommended practices. Under SWI, 400 ml cow urine, 225 g vermicompost and 110 g of jaggery were added per liter of water and thoroughly mixed with seed containing water. The mixture was left for 6-8 hours and then filtered. The filtered seeds were treated with bavistin 2.5 g kg^{-1} seed and kept in wet jute bag for 8-10 hours. The seeds were dried in shade for half an hour just before sowing to facilitate easy sowing of seeds [4].

The crop was sown on November 23, 2016 and November 19, 2017 with a plot size of 3 m x 4 m. Full dose of phosphorus, Muriate of potash and half dose of Nitrogen were applied to wheat as basal dose at the time of sowing. The remaining dose of N was top dressed at 30 Days after sowing. To workout the economics of different sowing method treatments information on the existing market price of seed, fertilizer and herbicides were used. Cost of labor was calculated by taking into account the prevailing labor wages at the time of investigation. Gross returns, net returns and benefit cost ratio were worked out by using the following formulae and expressed in Nepalese rupee (NPR).

Gross return= Grain yield x market rate of grain

Net returns= Gross returns- total cost of cultivation

$$\text{Benefit Cost ratio} = \frac{\text{Gross returns}}{\text{Total cost of cultivation}}$$

The weather data during wheat growing season was presented graphically in Fig 1and 2. All recorded data were analyzed through GENSTAT statistical package and treatment means were compared using least significant difference (LSD) test at $P \leq 0.05$.

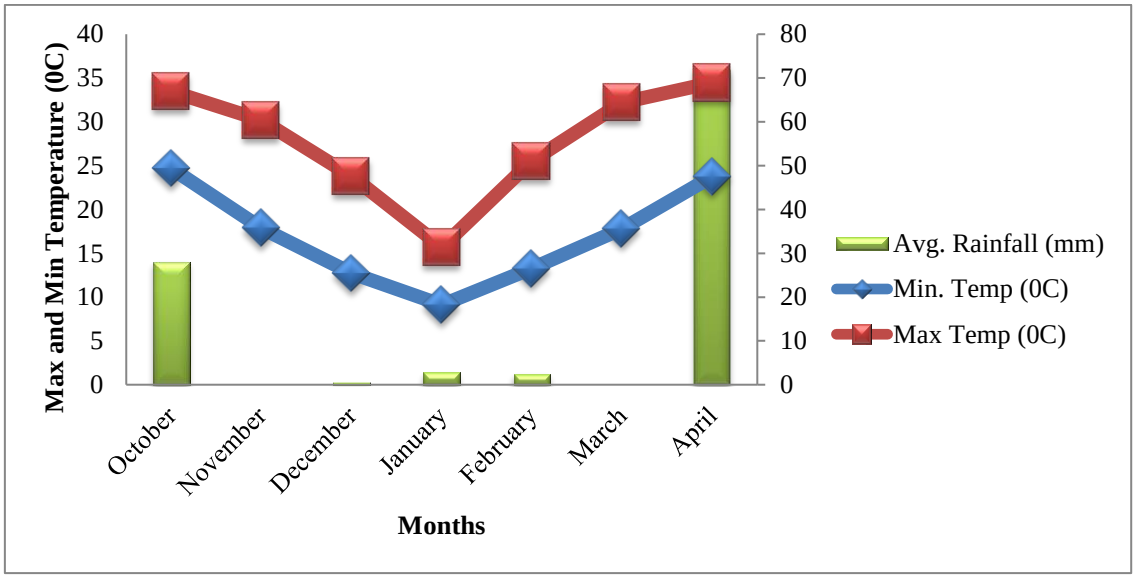

Fig 1 Weather data during wheat growing season, 2016/17

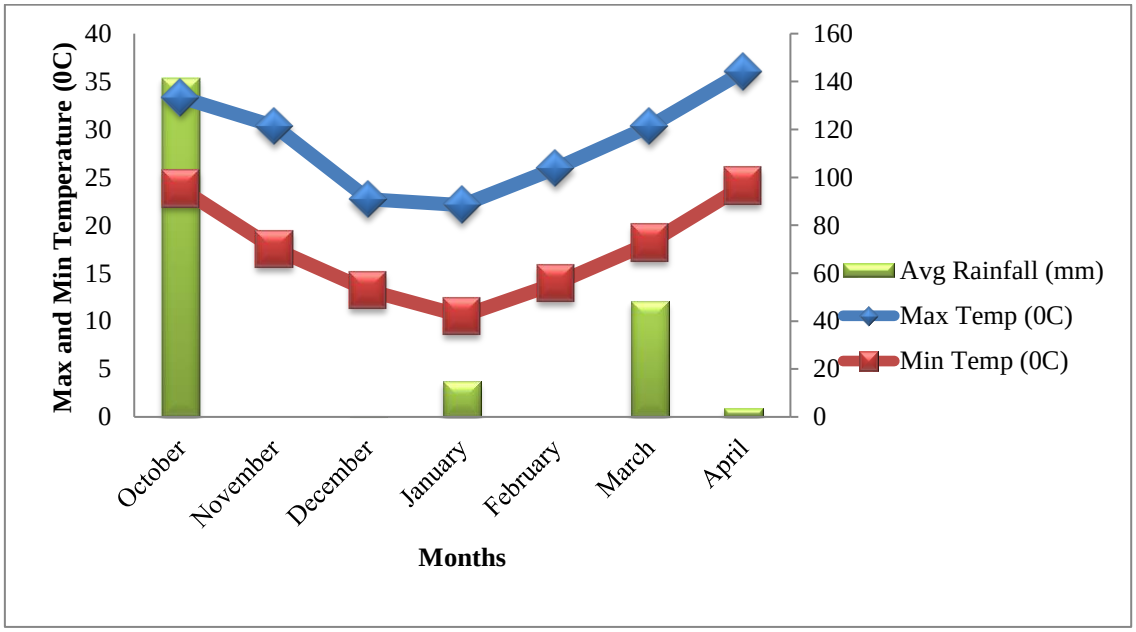

Fig 2 Weather data during wheat growing season, 2017/18

Results and Discussion

Effect of varieties

There was significant effect of variety on number of tillers per square meter but non significant effect was observed in plant height, panicle length, thousand grain weight and grain yield in both years (Table 1). Significantly highest numbers of tillers per square meter was recorded by Bandganga variety. However higher grain yield was recorded by Bandganga in comparison to yield of Vijay. Highest grain yield of

Bandganga might be due to higher number of tillers per square meter, panicle length and thousand grain weights. Combined analysis of both years' data also revealed the same results (Table 2). So, both tested improved wheat varieties; Vijay and Bandganga can be grown successfully under different sowing methods.

Effect of sowing methods

Plant height, number of tillers per square meter, thousand grain weight and grain yield were significantly different among different sowing methods while panicle length was not found significantly different (Table 1). SWI wheat sown at 20 cm × 20 cm spacing recorded significant higher tillers (267 and 251 m^{-2}) during both years but it was at par with line sowing (Table 1).

Table 1 Plant growth, yield and yield attributes of wheat as influenced by variety and sowing methods during 2016/17 and 2017/18

Treatments	Plant Height (cm)		Panicle Length (cm)		Number of tillers/m^2		1000 grain weight (gm)		Grain yield (kg/ha)	
	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18	2016/17	2017/18
Variety										
Vijay	81	80	11	11	195	222	51.7	41.7	3539	3070
Bandganga	83	83	12	12	285	226	51.5	42.8	3762	3291
F-test	ns	ns	ns	ns	*	ns	ns	ns	ns	ns
LSD (0.05)					63					
Sowing Methods										
Broadcasting	77	77	11	11	217	174	50.6	40.3	3533	2293
Line sowing (25 cm × continuous)	78	79	11	12	235	247	50.8	43.1	3680	3408
SWI (20 cm × 20 cm)	91	90	12	12	267	251	53.5	43.3	3739	3840
F-test	**	**	ns	ns	*	**	ns	*	ns	**
LSD (0.05)	5.8	5.8			38	45.23		1.9		506.8
Interaction										
F-test	ns	ns	ns	ns	ns	ns	ns	ns	ns	
Grand Mean	82	82	11	12	240	224	51.6	42.2	3651	3180
CV %	5.3	5.3	8.2	8.1	12	15.2	7.6	3.3	11.3	12

*** and *denotes significant at 1 % and 5% ns denotes non-significant*

Higher number of tillers m^{-2}, panicle m^{-2} and tillers $hill^{-1}$ obtained in rice planted under SRI method as compared to farmers practices [5]. Significantly higher thousand grain weight was recorded in SWI methods irrespective of spacing as compared to line sowing and broadcasting (Table 1). This may be due to the wider spacing and proper aeration under SWI method. The results revealed that there was significant difference in grain yield during 2017/18 and combined analysis of both year data also reflected the same results. SWI method of wheat sowing at 20 cm × 20 cm spacing recorded significantly higher grain yield (3840 kg/ha and 3789 kg/ha) during 2017/18 and combined analysis of 2016/17 and 2017/18 over other treatments (Table 1 and 2) but it was at par with line sowing . Similar results has also been reported by [6], from his experiment at farmers' fields at Sindhuli, Nepal where wheat variety 'Bhrikuti' has yielded 2.6, 2.4 and 2.3 kg/plot of 4 m^2 size i.e. 6.5, 6.0 and 5.75 t/ha in SWI, line sowing and broadcasting methods respectively.

Table 2 Plant growth, yield and yield attributes of wheat as influenced by variety and sowing methods (Combined analysis of 2016/17 and 2017/18)

Treatments	Plant Height (cm)	Panicle Length (cm)	Number of tillers/m^2	1000 grain weight (gm)	Grain yield (kg/ha)
Variety					
Vijay	81	11	208	46.7	3304
Bandganga	83	12	255	47.1	3527
F-test	ns	ns	*	ns	ns
LSD (0.05)			30		
Sowing Methods					
Broadcasting	77	11	195	45.9	2913
Line sowing (25 cm × continuous)	79	11	241	46.8	3544
SWI (20 cm × 20 cm)	91	12	259	48.0	3789
F-test	**	ns	**	ns	**
LSD (0.05)	5.3	0.4	35.68		300.8
Interaction					
F-test	ns	ns	ns	ns	ns
Grand Mean	82	11	232	46.9	3416
CV %	4.9	7.2	9.9	5.8	6.6

*** and *denotes significant at 1 % and 5% ns denotes non-significant*

Grain yield of wheat to the tune of 4.4, 3.5 and 2.0 t/ha with SWI at 25 cm × 25 cm plant spacing, line sowing at 25 cm and wheat sown under broadcast method respectively [7]. The Aga Khan Rural Support Program, working in farmers' fields at

Bihar has reported grain yield of wheat to the tune of 3.48 t/ha in SWI as compare to usual practice (2.63 t/ha) [2]. Perusal of results of present research in light of reports available from various agencies it may be inferred that the SWI methods are slightly superior than conventional line sowing and broadcasting methods of wheat with improved recommended practices and far superior to usual farmers practice.

Economics analysis

Combined analysis showed that line sowing of wheat at 25 cm was found to be more economical than SWI and broadcasting methods. Line sowing at 25 cm fetched net returns of NPR. 72,294 with a net benefit cost ratio of 1.75 (Table 3). It may be due to the fact that requirement of manual labor for sowing of wheat under SWI is much higher and labor shortage at the time of sowing is becoming a major constraint. Sowing of wheat by SWI method emerges to produce more grain yield but considering the cost and benefit of production it is not economical than line sowing until mechanization is done in SWI to replace required manual power.

Table 3 Economic returns and cost of cultivation of different Sowing methods of wheat cultivation (Combined analysis of 2016/17 and 2017/18)

Sowing Methods	Total Cost (NPR/ha)	Gross Returns (NPR/ha)	Net Returns (NPR/ha)	B:C Ratio
Broadcasting	42,680	87,390	44,710	1.05
Line sowing (25 cm × continuous)	41,376	1,06,320	72,294	1.75
SWI (20 cm × 20 cm)	43,676	1,13,670	62,644	1.43

Conclusion

The conclusion drawn from the study shows that wheat sown under system of wheat intensification (SWI) at 20 cm × 20 cm spacing is better than line sowing at 25 cm and broadcasting methods in terms of grain yield. However, it is not economical than line sowing due to higher cost incurred in labor. Therefore, mechanization in SWI should be developed in order to replace required manual power and get higher profit.

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Availability of data and material
Please contact the corresponding author for any data request.

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