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Comparison of growth attributes in raised and flatbed methods of sowing on wheat

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Abstract

A field experiment was conducted at research farm of Lovely Professional University during *rabi* season of 2017-18 and 2018-19 on variety HD 2967 of wheat. The experiment was laid out in RBD (Randomized Block Design) with nine treatments and three replications which involved treatments with different nitrogen doses. The crop was sown by two different methods *viz.* flatbed method (conventional method) and raised bed method. The experimental results showed that raised bed planted wheat with the application of 100% NPK improved the growth and grain yield through yield contributing characters like plant height (cm), number of tillers per plant, LAI, length of spike was observed highest in treatment 100% NPK (T6) on raised bed planted wheat for both the years. Similar trend was observed in case of number of grains per spike in (T6) treatment applied with 100% NPK on raised bed. 100 grain weight (g) was highest for treatment applied with 110% N with RDF of PK during both years of study. At the time of harvest according to the year 2017-18 maximum plant height was recorded in the treatment in T4 (102.3 cm). Although in the year 2018-19 the maximum result revealed for plant height was in treatment T6 (107.8 cm). According to year (2017-18 & 2018-19) the number of tillers at harvest stage was recorded significantly highest for T6 followed by T7 and T2 which are at par statistically. According to the year 2017-18 the results showed that number of leaves (2017-18) reported maximum (5) in T1 (RDF PK +75%N) followed by other treatments. Similarly in the year 2018-19 the maximum number of leaves was found in T6 (5) for treatment (T6) applied with 100% NPK on raised bed followed by T7, T1 (4). The results showed that leaf area index (2017-18) reported maximum (4.4) in T8 (RDF PK +130%N) followed by other treatments. Similarly in the year 2018-19 the maximum leaf area index was found in T6 (4.2) for treatment (T6) applied with 100% NPK on raised bed. Length of spike was noticed highest (11.8 cm) in T8 under condition with 30% higher N than recommended dose. It was also at par with T5, T6 and T7. During 2018-19 length of spike found highest (11.6 cm) in T6 under recommended dose of fertilizer on raised bed.

Keywords: Plant height, conventional bed, raised bed, wheat

Introduction

Wheat (*Triticum aestivum* L.) is most important crop among cereals and staple food for the world population. Wheat is a good source of carbohydrates and protein for human. The demand for food grains is expected to rise not only as a function of population growth but also as more and more people cross the poverty line with economic and social development. In India, 97.11 million metric tonnes of wheat production is recorded in 2017- 18. In India wheat crop occupied 29.8 million ha area for cultivation. Punjab has 35 lakh ha area under wheat cultivation was expected to produce 180 lakh metric tonnes during 2017- 18 (Anonymous, 2018). HD 2967 (2011) is a dwarf variety of wheat. It has profuse tillering. Ears are medium dense and its grains are medium bold and hard. It is moderately resistant to yellow rust. Average yield is 53.7 quintals per hectare. The optimum time for sowing of wheat in Punjab is from second fort night of October to the first fort night of December. This period requires low temperature at germination and vegetative stage and needs high temperature at time of harvest stage (Anonymous, 2017).

The planting of wheat during *rabi* season also experiences rainfall in winter season which often causes temporary flooding in flat method of sowing. So there is need to investigate different planting methods for reducing its water requirement when sown during *rabi* season. Raised bed method of planting may give higher grain yield as differentiate with conventional planting of wheat. The most requisite nutrient for crop production is nitrogen. It has an important role in metabolism of nucleotides, enzymes, vitamins, hormones. Nitrogen helps in utilization of potassium, phosphorus and other elements.

Phosphorus is necessary for early development and growth and helps to establish seedling. Raised bed planting systems has been used since time immemorial by farmers in many parts of the world. Raised bed planting method increases water use efficiency, fertilizer use efficiency, crop lodging condition (Govaerts *et al.*, 2007) [2]. The conventional flat planting is the common practice to raise crops in India. The better option for managing water, nutrients and weeds raised bed planting method may adopt. So good plant establishment achieved by adopting raised bed method. N uptake efficiency in wheat can be compare by crop response to low and high N doses. Nitrogen application was applied at that particular stage to enhance N use efficiency and profitability and reduce the deficiency of nitrogen (Mullen *et al.*, 2003) [4]. In India, for cultivation of wheat different methods are used such as flat and bed planting method to obtain maximum grain yield. In these methods bed planting method increase the yield of grain and straw in wheat crop as compare to flat method (Sagar *et al.*, 2017) [5]. Water management issues usually related with raised bed cultivation of crop to lessen additional water in rainfed conditions. All the biochemical processes in plants are mainly governed by nitrogen and which is essential for the growth and development of wheat (Sayre, 2006) [6]; (Kutman *et al.*, 2011) [8]. Less weed infestation was observed when wheat sown on beds than the conventional method. Biomass of weed under bed planting was lessen as compared to flatbed in wheat (Hassan *et al.*, 2005) [3].

Materials and Methods

The field experiment was performed in the Research Farm of Lovely Professional University situated at 31° 15' N and 75°42' E and 235 m above sea level in Punjab during *rabi* season 2017 – 2018 & 2018-19. This experimental field falls in Central Plain Zone (PB-3) of Punjab. Experiment was

conducted with 9 treatments replicated thrice in randomized block design with different nitrogen doses and two planting methods *viz.* flat and raised bed planting. Time of sowing is 2nd December 2017-18 & 2018-19 HD 2967 variety is taken for sowing. Observations are taken are plant height, number of leaves, leaf area index, number of tillers, length of spike (cm).

Results and Discussion

Plant height (cm) (2017-18 & 2018-19)

Plant height was observed after 30, 60, 90 days interval and at harvest stage (Table 1). At 30 DAS maximum plant height (2017-18) was registered for T7 (16.3 cm) treatment applied with RDF P&K+110% N on raised bed which was significantly at par with T2, T3 and T5 treatments. According to the year 2018-19 the maximum plant height was found (107.8 cm) for treatment (T6) applied with 100% NPK on raised bed followed by T2 (105 cm). At 60 DAS, the performance of crop in terms of plant height (2017-18) remained significantly superior for T4 (45.1 cm) conventional bed planted wheat with RDF PK+130%N. Similarly, at 60DAS maximum plant height (2018-19) was found in the treatment T6 (44.7 cm) applied with 100% NPK. At 90 DAS, significantly highest plant height (2017-18) was observed for T6 treatment and also at par with T2 and T3. According to the year 2018-19 the maximum plant height was found in T3 treatment (72.7 cm). At the time of harvest according to the year 2017-18 maximum plant height was recorded in the treatment in T4 (102.3 cm). Although in the year 2018-19 the maximum result revealed for plant height was in treatment T6 (107.8 cm). Similar results were reported by Singh *et al.*, (2009) [9] where higher plant height in wheat was found under raised bed planting than the conventional method.

Table 1: Plant height during crop growth period (2017-18) & (2018-19) for different treatments

Treatments	Plant height (cm)							
	30 days (2017-18)	30 days (2018-19)	60 days (2017-18)	60 days (2018-19)	90 days (2017-18)	90 days (2018-19)	At harvest (2017-18)	At harvest (2018-19)
Conventional method								
T0 Control	11.3 ^c ±0.6	10.2 ^d ±0.1	38.8 ^c ±0.4	38.8 ^c ±0.4	60.8 ^b ±0.6	60.0 ^d ±0.5	82.3 ^b ±1.4	95.0 ^g ±0.5
T1 RDF PK+75%N	13.3 ^{abc} ±1.4	11.1 ^d ±0.0	42.0 ^b ±1.1	40.4 ^{de} ±0.3	69.3 ^a ±4.8	69.6 ^{bc} ±0.3	96.8 ^a ±4.5	97.7 ^f ±0.6
T2 100% NPK	15.6 ^{ab} ±0.6	15.6 ^a ±0.3	43.0 ^{ab} ±0.5	42.6 ^b ±0.8	73.6 ^a ±0.6	69.6 ^{bc} ±0.8	101.3 ^a ±0.6	105.0 ^b ±0.5
T3 RDF PK+110%N	15.6 ^{ab} ±0.3	15.3 ^a ±0.8	43.3 ^{ab} ±0.3	40.7 ^{cd} ±0.3	73.0 ^a ±1.1	72.7 ^a ±0.6	101.0 ^a ±0.5	100.9 ^{cd} ±0.5
T4 RDF PK+130%N	13.6 ^{abc} ±1.6	11.6 ^{cd} ±0.2	45.1 ^a ±0.6	39.1 ^{de} ±0.5	72.0 ^a ±0.5	71.5 ^{ab} ±0.8	102.3 ^a ±1.3	98.6 ^{ef} ±0.3
Raised bed								
T5 RDF PK + 75%N	15.3 ^{ab} ±1.2	13.2 ^b ±0.5	44.6 ^a ±0.3	42.3 ^{bc} ±0.6	71.4 ^a ±1.3	69.0 ^c ±0.5	99.5 ^a ±0.2	99.6 ^{de} ±0.8
T6 100% NPK	12.5 ^{bc} ±0.8	16.7 ^a ±0.2	42.3 ^b ±0.6	44.7 ^a ±0.2	74.0 ^a ±0.5	71.0 ^{abc} ±0.5	102.0 ^a ±0.5	107.8 ^a ±0.4
T7 RDF PK+110%N	16.3 ^a ±0.3	15.7 ^a ±0.2	41.1 ^b ±0.4	42.7 ^b ±0.9	72.0 ^a ±0.5	69.4 ^c ±0.2	100.6 ^a ±0.6	101.7 ^c ±0.3
T8 RDF PK+130%N	14.3 ^{abc} ±0.6	12.7 ^{bc} ±0.7	41.1 ^b ±1.0	40.9 ^{bcd} ±0.3	68.6 ^a ±2.4	69.3 ^c ±0.6	99.6 ^a ±0.8	97.7 ^f ±0.3

* DMRT (Duncan's multiples range test), the data followed by various letters are significantly at $p < 0.05$ for separation of means.

Number of tillers/plant (2017-18 & 2018-19): Number of tillers was recorded after 30, 60, 90 days and at harvest stage (Table 2). According to the year 2017-18 number of tillers were recorded maximum (29) per plant in T6 followed by T8. The performance of crop in terms of number of tillers at 60 DAS for T6 showed supremacy over other treatments. At 90 DAS, also numbers of tillers were highest for T6. However at harvest considerable maximum number of tillers per plant observed for T6, which was at par with T2 also. Similarly, according to the year 2018-19 number of tillers were recorded maximum (31) per plant in T6 followed by T8. The performance of crop in terms of number of tillers at 60 DAS for T6 (30) showed supremacy over other treatments. At 90

DAS, also numbers of tillers were highest for T6 (29). However at harvest considerable maximum number of tillers per plant observed for T6 (27), which was at par with T2 also. It is interesting to note here, that number of tillers was highest in recommended dose applied treatments in flat or raised bed planted wheat. Higher or lower dose of nitrogen showed no increment in number of tillers with change of planting method. A similar study was conducted by Farooq and Cheema, (2014) where wheat planted on raised beds produced the maximum productive tillers, grains/spikes and test weight. According to year (2017-18 & 2018-19) the number of tillers at harvest stage was recorded significantly highest for T6 followed by T7 and T2 which are at par statistically (Table 2).

Table 2: Number of tillers per plant during crop growth period (2017-18) & (2018-19) for treatments

Treatments	Number of tillers/plant								
	30 days (2017-18)	30 days (2018-19)	60 days (2017-18)	60 days (2018-19)	90 days (2017-18)	90 days (2018-19)	At harvest (2017-18)	At harvest (2018-19)	
Conventional method									
T0	Control	18.6 ^c ±0.3	20 ^c ±0.5	16.6 ^d ±0.3	16.6 ^c ±0.8	15.6 ^d ±0.3	16.0 ^c ±1.1	14.6 ^c ±0.3	15.6 ^d ±0.6
T1	RDF PK +75%N	22.6 ^{bc} ±2.4	23 ^d ±0.5	20.3 ^{bcd} ±2.7	21.0 ^c ±1.1	18.6 ^{bcd} ±2.6	20.0 ^d ±0.5	18.6 ^{abc} ±1.6	19.3 ^{bcd} ±0.3
T2	100%NPK	26.6 ^{ab} ±2.9	26.3 ^c ±0.3	24.3 ^{ab} ±2.6	24.6 ^c ±0.3	23.3 ^{ab} ±2.9	23.6 ^{bc} ±0.3	21.6 ^a ±2.7	22.0 ^b ±0.5
T3	RDF PK + 110%N	23.0 ^{abc} ±1.0	30.3 ^{ab} ±0.3	22.0 ^{abc} ±0.5	27.3 ^{abc} ±1.3	19.6 ^{abcd} ±1.2	25.6 ^b ±1.2	18.3 ^{abc} ±0.8	21.3 ^{bc} ±1.4
T4	RDF PK + 130%N	21.0 ^c ±1.5	24.3 ^{cd} ±0.8	18.0 ^{cd} ±1.7	20.3 ^d ±0.8	16.6 ^{cd} ±1.4	19.0 ^d ±0.5	15.6 ^{bc} ±1.4	17.3 ^{cd} ±0.3
Raised bed									
T5	RDF PK + 75%N	23.3 ^{abc} ±1.4	30.0 ^{ab} ±1.0	22.6 ^{abc} ±1.7	26.0 ^{bc} ±0.5	21.6 ^{abc} ±1.2	25.0 ^b ±0.5	21.0 ^a ±2.0	20.0 ^{bc} ±2.6
T6	100%NPK	28.3 ^a ±1.4	31.6 ^a ±0.3	26.6 ^a ±1.2	30.3 ^a ±1.3	24.6 ^a ±1.2	29.0 ^a ±1.1	23.0 ^a ±1.0	27.0 ^a ±1.5
T7	RDF PK + 110%N	26.3 ^{ab} ±0.6	29.3 ^b ±0.8	24.0 ^{ab} ±0.5	28.3 ^{ab} ±1.2	21.3 ^{abc} ±0.6	25.0 ^b ±1.2	20.0 ^{ab} ±0.0	23.0 ^b ±0.5
T8	RDF PK + 130%N	27.3 ^{ab} ±1.2	24.6 ^{cd} ±0.8	25.0 ^{ab} ±1.0	21.3 ^d ±0.8	22.6 ^{ab} ±0.3	21.0 ^{cd} ±1.0	21.0 ^a ±0.5	20.6 ^{bc} ±1.2

* DMRT (Duncan's multiples range test), the data followed by various letters are significantly at $p < 0.05$ for separation of means.

Number of leaves/plant, LAI and Length of spike (2017-18 & 2018-19)

Number of leaves per plant is an essential component for photosynthesis, leaf area index and also affects the grain yield. Significant difference was found between the treatments in terms of leaf number per plant. According to the year 2017-18 the results showed that number of leaves at 60 DAS reported maximum (5) in T1 (RDF PK +75%N) followed by other treatments (Table 3). Similarly in the year 2018-19 the maximum number of leaves was found in T6 (5) applied with 100% NPK on raised bed followed by T7, T1 (4). According to the year 2017-18 the results showed that leaf area index reported maximum (4.4) in T8 (RDF PK

+130%N) followed by other treatments (Table 3). Similarly in the year 2018-19 the maximum leaf area index was found in T6 (4.2) for treatment (T6) applied with 100% NPK on raised bed. Identical results were found in the research of Mollah *et al.* (2015) [9] where leaf area index found maximum on raised bed planted wheat. Length of spike was noticed highest (11.8 cm) in T8 under condition with 30% higher N than recommended dose. It was also at par with T5, T6 and T7 (Table 3). During 2018-19 length of spike found highest (11.6 cm) in T6 under recommended dose of fertilizer on raised bed. This result is agreed with the findings of Hashimi, S. M *et al.* (2019) [10] they reported that by planting wheat on raised bed showed 20% increase in spike length.

Table 3: Number of leaves/plant, LAI and Length of spike during crop growth period (2017-18 & 2018-19) for different treatments

Treatments	No. of leaves /plant(2017-18)	No. of leaves /plant(2018-19)	LAI (2017-18)	LAI (2018-19)	Length of spike (cm) (2017-18)	Length of spike (cm) (2018-19)
Conventional method						
T0	Control	3.3 ^{ab} ±0.3	2.6 ^c ±0.3	2.4 ^d ±0.1	2.4 ^d ±0.1	8.5 ^c ±0.2
T1	RDF PK +75%N	4.6 ^a ±0.3	4.3 ^{ab} ±0.3	2.8 ^{cd} ±0.4	3.0 ^{cd} ±0.2	10.5 ^b ±0.5
T2	100% NPK	4.0 ^{ab} ±0.5	3.0 ^c ±0.0	3.2 ^{bcd} ±0.1	3.3 ^{bcd} ±0.1	11.5 ^{ab} ±0.2
T3	RDF PK +110%N	3.3 ^{ab} ±0.3	3.6 ^{abc} ±0.3	3.5 ^{bc} ±0.1	3.8 ^{abc} ±0.4	10.5 ^b ±0.2
T4	RDF PK +130%N	3.6 ^{ab} ±0.6	3.3 ^{bc} ±0.3	3.8 ^{ab} ±0.4	3.5 ^{abc} ±0.1	11.0 ^{ab} ±0.5
Raised bed						
T5	RDF PK +75%N	3.0 ^b ±0.0	3.6 ^{abc} ±0.3	2.8 ^{cd} ±0.3	3.1 ^{bcd} ±0.5	11.6 ^{ab} ±0.3
T6	100% NPK	4.3 ^{ab} ±3.3	4.6 ^a ±0.3	3.3 ^{bc} ±0.1	4.2 ^a ±0.1	11.6 ^{ab} ±0.3
T7	RDF PK +110%N	3.3 ^{ab} ±0.3	4.3 ^{ab} ±0.3	3.9 ^{ab} ±0.3	4.0 ^{ab} ±0.2	11.6 ^{ab} ±0.3
T8	RDF PK +130%N	4.0 ^{ab} ±0.5	3.3 ^{bc} ±0.3	4.4 ^a ±0.2	3.2 ^{bcd} ±0.1	11.8 ^a ±0.1

* DMRT (Duncan's multiples range test), the data followed by various letters are significantly at $p < 0.05$ for separation of means

Conclusion

The experiment was conducted at the Agriculture Research Farm of Department of Agronomy, School of Agriculture Lovely Professional University, Punjab (India) during *rabi* season 2017-18 and 2018-19 on HD2967 variety of wheat. The experiment was laid out in RBD (Randomized Complete Block Design) with 9 treatments *viz.* control (T0); Recommended Dose of PK +75% N (T1); 100% NPK (T2); Recommended Dose of PK +110% N (T3); Recommended Dose of PK +130% N (T4); Recommended Dose of PK +75% N (T5); 100% NPK (T6); Recommended Dose of PK + 110% N (T7); Recommended Dose of PK + 130% N (T8) with three replications.

The result of the experiment has been summarized here

- Variety HD 2967 when planted in raised bed showed increase in growth parameters in both the years as compared to flatbed (conventional method) except

number of leaves and length of spike.

- At the time of harvest according to the year 2017-18 maximum plant height was recorded in the treatment in T4 (102.3 cm). Although in the year 2018-19 the maximum result revealed for plant height was in treatment T6 (107.8 cm). According to year (2017-18 & 2018-19) the number of tillers at harvest stage was recorded significantly highest for T6 followed by T7 and T2 which are at par statistically.
- According to the year 2017-18 the results showed that number of leaves reported maximum (5) in T1 (RDF PK +75%N) followed by other treatments. Similarly in the year 2018-19 the maximum number of leaves was found in T6 (5) for treatment (T6) applied with 100% NPK on raised bed followed by T7, T1 (4). The results showed that leaf area index (2017-18) reported maximum (4.4) in T8 (RDF PK +130%N) followed by other treatments. Likewise in the year 2018-19 the maximum leaf area

index was found in T6 (4.2) for treatment (T6) applied with 100% NPK on raised bed. Length of spike was noticed highest (11.8 cm) in T8 under condition with 30% higher N than recommended dose. It was also at par with T5, T6 and T7. During 2018-19 length of spike found highest (11.6 cm) in T6 under recommended dose of fertilizer on raised bed.

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