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Research Article

Wheat productivity in response to ridge sowing and nitrogen application on rainfed condition

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Abstract

Wheat cultivation in Pakistan is carried out on more than half area in rain fed condition. To improve the average yield of country the only possible reason is to enhance productivity of wheat crop in dry areas. Current study response of wheat productivity to ridge sowing method and nitrogen levels was studied in rain fed condition at the research farm of The University of Swabi, during 2015-16. The experiment was carried out in split plot design having four replications. Sowing methods were assigned to main plot while nitrogen levels were allotted to sub plot factors. It was observed that on ridge bed sowing method tiller per meter square (256), productive tiller (216.55), thousands grains weight (46.110), biological yield (8549.1), grain yield (2429.5) and harvest index (33.50) were significantly increases over flat method. In case of nitrogen application maximum tiller per meter square (240.12 Numbers), productive tiller (240.12 Numbers), thousands grains weight (59.70 g), biological yield (7388.7 kg ha^{-1}), grain yield (2396.96 kg ha^{-1}) and harvest index (32.50) were recorded in plots receiving nitrogen at the rate of 120 kg ha^{-1}. Thus it is concluded that sowing of wheat on ridges produces maximum yield as compare to flat sowing and nitrogen application at the rate of 120 kg N ha^{-1} had higher yield than rest therefore it is recommended that wheat sowing on ridges with the application of 120 kg N ha^{-1}in rainfed areas can improve the wheat productivity in Pakistan.

Keywords: Flat sowing; Nitrogen; Productivity; Ridge; Wheat

Introduction

In current era the tremendous increase in human population need great attention towards the agriculture sector to provide satisfactory food for human needs. Wheat is used as a major staple food crop in Pakistan [1], its production is not enough to supply food to whole Pakistan population because about 80 percent arable land are come under rain fed condition where special techniques are required to carry proper agriculture practices. Sowing of wheat crop on ridges is one of technique which can improve wheat productivity by holding proper moisture,

greater nutrients availability and good crop stand in rain fed areas. During 2015-16, the area under wheat cultivation increased to 9260 thousands hectares from last year area to 9204 thousand hectares which shows an increase of 0.6 percent, while the production of wheat was recorded stood at 25.482 million tons during 2015-16 (Pakistan economic survey (2015-16) [2].

Wheat yield varies mostly due to change in its contributing characters because yield per unit area is the product of several contributing factors including traits related to the growth attributes and number and weight of grains [3]. However wheat yield can be increased through development of productive genotypes which better adapt various agro, climate condition and also resist all types of stresses. In Khyber Pakhtunkhwa, the total area under cultivation is about 1.92 million hectares out of which 1.2 million comprises of dry land farming which is more than 60%. The total area in KPK under wheat is 0.72 million hectares out of which 57% (0.41 million hectares) of cultivated area is rain fed [4].

The climate of Peshawar valley is conducive to growth and production of wheat, having high-yielding varieties, ample resources, fertile land and hardworking farmers. But the growers fail to achieve the optimum potential of wheat crop. There are many constraints in raising wheat crop [5].

Wheat flat planting with flood irrigation leads to inferior water use efficiency and lower crop yield. This practice also results in greater crop lodging and enhanced frequency of crop diseases (6). It has been estimated that over 90% of the agricultural production comes from irrigated areas [7,8] describes that the bed and furrow sowing technique is an important improvement in the application efficiencies of using irrigation water.

Ridge planting method is recommended for good crop yield in rain fed area. Ridge planting method increased crop yield, reduced demand for irrigation water, reduced expenses on agricultural inputs, increased farm income, simplified farm operations increased soil moisture, improved soil cover, reduced salinity.

[9] Reported that spilt N application had little effect on yield, but decreased lodging and spike population, while grain weight increased. [10] Reported that spike numbers and grain weight were increased with high level of nitrogen.

Thus growing wheat crop on ridge is very useful because it demand low inputs, easier method to farmer give more production ,improved soil physical properties.

Materials and methods

An experiment entitle “Response of wheat productivity to different sowing methods and nitrogen Levels” was carried out at the research farm of The University of Swabi, Khyber Pakhtunkhwa, Pakistan in rabi 2015-16. The experiment was carried out in split plot arrangements having four replications. Sowing methods was assigned to main plot while nitrogen levels were allotted to sub plot factors. Land was ploughed with cultivator and ridger. The plot size of 3 m × 5 m was maintained. Each plot have five rows, 5m length and ridge to ridge spacing was 60 cm. Wheat variety Pirsabak-2013 was sown at a uniformed seed rate of 100 kg ha^{-1}. Five levels of nitrogen were used. Half of nitrogen was applied at sowing time. The remaining half nitrogen was applied after four weeks of sowing. All the agronomic practices were applied uniformly throughout the experiment.

Factor A: Sowing methods

1. Ridge bed sowing
2. Flat sowing

Factor B: Nitrogen level (urea kg ha^{-1})

1. 100
2. 120
3. 140
4. 160
5. 200

Statistical analysis

Data of the parameters were analyzed statistically following appropriate method using computer software Statistix 8.1. Mean were separated using least significant difference test.

Results and discussion

Tiller m^{-2}

Data regarding tiller $m^{-2}$are shown in table 1. Highest number of tillers was recorded in those plots where ridge sowing method was done (256.55). While less number of tiller was recorded in those plots where flat sowing method was done (238.40). However, in case of nitrogen application maximum number of tiller (262.37) was recorded at 200 kg N ha^{-1} followed by 160 kg N ha^{-1} (253.13) while minimum number of tiller was recorded in those plots where nitrogen was applied at the rate of 100 kg N ha^{-1} (235.25). However, the effects of sowing methods and interaction of sowing methods and nitrogen were found significant in which the highest values was recorded in ridge sowing receiving nitrogen rate of 200 kg ha^{-1}, while the lowest number of tillers per meter square were observed in flat sowing receiving nitrogen rate of 100 kg ha^{-1}. Plant tiller mainly depend on crop stand **[11]**, root penetration **[12]** proper nutrients application **[13]**. These findings results were supported by **[14]** who reported that nitrogen rates significantly increase number of tillers.

Productive tiller

Data regarding productive tiller are shown in table 1. Highest number of tillers was recorded in those plots where ridge sowing method was done (256.55). Similarly less number of tiller was recorded in those plots where flat sowing method was done (238.40). However, in case of nitrogen application maximum number of tiller (262.37) was recorded at 200 kg N ha^{-1} followed by 160 kg N ha^{-1} (253.13) while minimum number of tiller was recorded in those plots where nitrogen was applied at the rate of 100 kg N ha^{-1} (235.25).Productive tiller mainly depend on soil fertility **[15]**, proper nutrients application **[16]** and on the water availability **[17]**. However, the effects of sowing methods and interaction of sowing methods and Nitrogen were found significant in which the highest values was noted in ridge sowing receiving nitrogen rate of 200 kg ha^{-1}, while the lowest number of tillers per meter square were recorded in flat sowing receiving nitrogen rate of 100 kg ha^{-1}. These findings were supported by **[14]** who reported that nitrogen rates significantly increase number of tillers. **[18]** also show that bed sowing of wheat not only saves water but improves fertilizer use efficiency.

Thousand grain weight (g)

Data regarding thousand grain weights were shown in table 2. Highest thousand grain weight was obtained in those plots where ridge sowing method was done (64.110). While less amount of thousand grain weight were recorded in those plots where flat sowing method was done (47.185). In case of nitrogen application maximum number of thousands grains weight (60.70) were recorded at 100 kg N ha^{-1} (60.70) followed by 120 kg N ha^{-1} (59.70). Similarly minimum amount of thousand grain weight (49.18) were recorded at 200 kg N ha^{-1}. However, the effect of sowing method and interaction of sowing methods and nitrogen were found significant. Grain weight mainly depends on soil fertility (19), number of tiller and productive tiller **[20]**, and proper nutrients application **[21]**. Our results are in line with **[22]** shows that grain weight were significantly improved by nitrogen application.

Biological yield (kg ha^{-1})

Data regarding biological yield were shown in table 2. High biological yield was recorded in those plots ridge bed sowing method (8549.1) while less amount of biological yield was found in those plots where flat sowing method was done (6889.6). While maximum biological yield (8456.3) was

obtained at 200 kg N ha^{-1} followed by 160 kg N ha^{-1} (8021.8). However, the effects of sowing methods and interaction of sowing methods and nitrogen were found significant in which the highest values was recorded in ridge sowing receiving nitrogen rate of 200 kg ha $^{-1}$, while the lowest number of tillers per meter square were observed in flat sowing receiving nitrogen rate of 100 kg ha $^{-1}$. Biological yield is mainly depending on crop stand [23], root penetration [24] and nitrogen application [25]. Our results are with line [26] who reported that nitrogen increase biological yield. Similarly [27] stated that ridge sowing method increase biological yield.

Table 1. Tiller per meter square and productive tiller of wheat is affected by different level of Nitrogen and sowing methods.

Treatments	Tiller m^{-2}	Productive Tiller
Sowing Methods		
Ridge	256.55 a	216.55 a
Flat	238.40 b	208.40 b
$LSD_{0.05}$	6.8274	8.274
Nitrogen (kg N ha^{-1})		
100	235.25 e	215.25 e
120	240.12 d	220.12 d
140	246.50 c	216.50 c
160	253.13 b	203.13 b
200	262.37 a	242.37 a
$LSD_{0.05}$	3.202	4.102
SM x N interaction	**	**

Mean value of the same category followed by different letters are significant at P≤0.05 level

Table 2. Thousand grain weight of wheat is affected by different level of Nitrogen and sowing methods.

Treatments	Thousand grain Weight	Biological yield
Sowing Methods		
Ridge	46.110 a	8549.1 a
Flat	42.185 b	6889.6 b
$LSD_{0.05}$	4.697	161.27
Nitrogen (kg N ha^{-1})		
100	41.700 a	7078.4 e
120	43.700 a	7388.7 d
140	42.36 a	7651.9 c
160	41.28 b	8021.8 b
200	40.18 c	8456.3 a
$LSD_{0.05}$	2.39	78.436
SM x N interaction	**	**

Mean value of the same category followed by different letters are significant at P≤0.05 level

Grain yield (kg ha $^{-1}$)

Data regarding grain yield were shown in table 3. High grain yield (2429.5 kg ha^{-1}) were obtained in those plots where ridge sowing method was done. While less amount of grain yield (2123.2 kg ha^{-1}) was recorded in those plots where flat sowing methods was done. In case of nitrogen application maximum amount of grain yield (2396.99 kg ha^{-1}) was obtained at 120 kg N ha $^{-1}$ while minimum amount of grain yield was obtained at the rate of 140 kg N ha $^{-1}$. However, the

effects of sowing methods and interaction of sowing methods and nitrogen were found significant in which the highest values was recorded in ridge sowing receiving nitrogen rate of 120 kg ha $^{-1}$, while the lowest number of tillers per meter square were observed in flat sowing receiving nitrogen rate of 100 kg ha $^{-1}$. Grain yields mainly depend upon on soil organic matter **[28]**, moisture content **[29]** and nutrient availability **[30]**. Our results were supported by **[31]** who stated that ridge bed sowing method significantly increase grain yield. Similarly **[32]** also stated that nitrogen increase grain yield.

Harvest index (%)

Data regarding harvest index were shown in table 3. Highest harvest index (33.50) were obtained in those plots where ridge sowing method was carried out. While lowest amount of harvest index (28.550) was obtained in those plots where flat sowing method was carried out. Similarly maximum number of harvest index (33.50) was obtained at 120 kg N ha^{-1} while less amount of harvest index was found at the rate of 100 kg N ha^{-1}(31.37). However the effect of sowing methods and the interaction of sowing method and nitrogen were found significant in which the highest values was recorded in ridge sowing receiving nitrogen rate of 120 kg ha^{-1} while the lowest number of tillers per meter square were observed in flat sowing receiving nitrogen rate of 200 kg ha $^{-1}$. Harvest index of wheat mainly depends upon on biological yield and grain yield. Our results were supported by **[32]** that nitrogen levels increases harvest index.

Table 3. Grain yield and harvest index of wheat is affected by different level of Nitrogen and sowing methods.

Treatments	Grain yield	Harvest index
Sowing Methods		
Ridge	2429.5 a	33.550 a
Flat	2123.2 b	28.550 b
$LSD_{0.05}$	100.16	0.842
Nitrogen (kg N ha^{-1})		
100	2227.1c	31.37 b
120	2396.9 a	32.50 a
140	2333.3 b	30.62 c
160	2258.1 c	28.25 d
200	2166.4 d	25.75 e
$LSD_{0.05}$	49.47	0.7174
SM x N interaction	**	**

Mean value of the same category followed by different letters are significant at P≤0.05 level

Conclusion and recommendation

It was concluded from the study that ridge sowing of wheat increased yield and yield components of wheat as compare to flat sowing. Similarly the application nitrogen at the rate of 120 kg ha^{-1} resulted in maximum yield production of wheat. Therefore sowing of wheat on ridges with the application of nitrogen at the rate of 120 kg ha^{-1} is recommended for optimum crop production in rainfed condition.

Authors' contributions

Conceived and designed the experiments: M Ibrahim & IU Rahman, Performed the experiments: A Rehman, J Ali & Attaullah, Analyzed the data: MA Raza, Contributed materials/ analysis/ tools: Irshad Ali Khan, Wrote the paper: SA Khan & J Khan.

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