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Effect of different methods of sowing and row orientation on growth, yield and quality of wheat (*Triticum aestivum* L.)

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ABSTRACT

A field experiment was conducted during *Rabi* season of 2015-16 at the Students' Research Farm, Khalsa College Amritsar, on sandy loam soil, low in organic carbon and available N, Medium in available P and high in available K. Field experiment was laid out in split plot design comprising four methods of sowing such as (Bed Planting, Zero tillage, Flat drilling, Happy seeder) and two row orientation as (North-South and East-West) replicated four times. Bed planting method produced significantly higher growth characters (*i.e*. plant height, leaf area index and dry matter accumulation, yield contributing characters effective tillers, grains ear^{-1}, grain and straw yield, harvest index and B C ratio) than happy seeder and zero tillage sowing Bed planting recorded 14% and 10.48% higher grain yield over happy seeder and zero tillage sowing, respectively. Between row orientations, north-south row orientation produced higher growth and yield attributes than east-west whereas grain yield and biological yield was 3.86% and 3.77% higher than east-west sowing direction respectively.

Key words: Growth, Quality, Row orientation, Sowing methods, Wheat, Yield.

INTRODUCTION

Wheat *(Triticum aestivum* L.) is the premier cereal crop and is the major staple food of the world (Yongqing, 2005)). Wheat was grown in India on 31 million ha with production of 86.53 million tonnes whereas, in Punjab it covers 3.5 million ha with a production of 15.05 million tonnes (Anonymous, 2015). Although the average productivity of Punjab is almost double (4300kg/ha) as compare to the average productivity of India (2791.19 kg/ha), but still it far behind as compare to the average productivity of major wheat growing countries of the world. At present the natural resources, *viz* soil, water and environment are under great stress to maintain the production sustainability with conventional methods of cultivation. Mono cropping system of rice-wheat cultivation has further narrowed down the benefit cost ratio of the wheat cultivated districts of Punjab because of high input cost and shortage of labour in peak season. As rice –wheat cropping system occupies about 83 per cent of the total cultivable area of the Punjab has degraded the soil physical and properties at large because of conventional tillage practices in wheat and repeated rounds of puddlings in rice. (Malik *et al.* 2006). These changes caused in yield reduction, degradation of soil fertility and productivity. If these practices should be in use as such, then soil may become barren and inherent fertility of soil may be lost. So there is need to evaluate different techniques or methods of tillage and sowing to check further decline in wheat production. Plant stand design affects the availability of various factors *viz*. harvesting of light, availability of water, uptake of nutrients and suppression of weeds. Plant stand design affects many factors such as light interception, water, nutrients and weeds which are crucial for crop production (Brant *et al.*, 2009). Methods of sowing constitute an important component of physical environment of soil and therefore, could affect the crop establishment, growth and yield of crops by its impact on plant rooting, soil nutrients and moisture extraction pattern (Mollah *et al*. 2009).The conventional practices of soil cultivation are unable to maintaining the soil physico-chemical properties and sustainability. Therefore, the cultivation of various other methods of sowing such as bed planting, happy seeder, flat drilling, zero tillage is need of the day to enhance productivity apart from maintaining sustainability and soil heath. The above experiment was designed to find out the effect of sowing methods and row orientation on growth, yield and quality characters of wheat.

MATERIALS AND METHODS

A field experiment was conducted during *Rabi* season of 2015-16 at the Students' Research Farm, Khalsa College Amritsar (31º 38′ N, 72º 52′ E and 236 metres above mean sea level). The soil was sandy loam, having PH 7.8, organic carbon 0.49, available nitrogen 164.5 kg/ha, phosphorus 19kg/ha and potassium 347.5 kg/ha in the plough layer. Experiment was laid out in split plot design comprising four methods of sowing such as (T_1= Bed Planting, T_2= Zero tillage, T_3= Flat drilling, T_4= Happy seeder) and two row

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orientation as (T_5= North-South and T_6= East-West) replicated four times with gross plot size 4.5 x 4.5 m. (20.25m^2). Observations recorded at harvesting were taken from net plot of 4m x 4m (12.96 m^2) size by leaving two rows from each side to reduce the error while applying the suitable statistical techniques. In case of bed planting one bed was left from either side to record observations from net plot of size 3.83x3.83 (14.67m^2). After giving primary tillage to selected field, heavy pre sowing irrigation (rauni) was given to whole field. When field reached proper moisture conditions the selected field was ploughed twice with cultivars followed by planking to prepare fine seed bed for drilling. Beds were prepared with the help of bed planter of standard size of 67.5cm and remaining field keep without tillage for zero tillage and happy seeder sowing. Wheat variety HD 2967 was used in the experiments @ seed rate of 100 kg/ha and sowing was done on 12 November 2015. All the required agronomic practices were followed uniformly in all the plots through out the growing period. The plots were thoroughly irrigated 25 days interval. The recommended dose of fertilizers was applied. Phosphorus was applied before sowing and nitrogen was applied in three equal split doses. Nitrogen and phosphorus nutrients were applied in the form of urea and DAP. To check the weed growth one spray of clodinofop 15WP (400 g/ha) and metsolfuron 20 WP (10 g/ha) herbicide was applied after first irrigation. Growth parameters like emergence count, plant height, leaf area index, dry matter accumulation, number of tillers, yield parameters like, number of grains per ear, test weight, grain yield, straw yield, harvest index, quality parameters like N content in grains and straw, protein content in grains and economics study like benefit cost ratio were recorded.

Statistical Analysis: Statistical analysis of the data recorded was done as per split plot design (Cochran *et al*, 1963) using CPCS-1 software developed by the Department of Mathematics and Statistics, PAU, Ludhiana. The comparison was made at five per cent level of significance.

RESULTS AND DISCUSSION

Emergence count: Different sowing methods and row orientations had not shown any significant effect on emergence count per metre row length.

Plant height: The variation in plant height was observed in sowing methods and row orientation.. Among the planting methods, bed planting recorded taller plants(95.42 cm) might be due to the proper establishment of plants in bed planting. N-S row orientation also recorded 2.18 per cent taller plants than E-W row orientation. These results are in agreement with the results reported by Shekhar (Shekhar *et al*. 2014) and Pandey (Pandey *et al*. 2013).

Dry matter accumulation: Bed planting recorded 8.36 per cent higher dry matter than happy seeder at harvest. It may be attributed due to proper distribution of plants, more height of plants, number of tillers and LAI. N-S row orientation was significantly produce more dry matter than E-W at harvest and recorded 2.63 per cent more dry matter accumulation than E-W row orientation because of more number of tillers in north-south as compare to east-west. These findings were in tune with Radwan (Radwan *et al*, 2013) and Kumar (Kumar *et al*, 2012).

Leaf area index: Leaf area index under bed planting was observed at par with that of wheat sown with flat drilling method but observed significantly higher than all other treatments. This may be because of better availability of inputs and suitable edaphic conditions for better plant growth. Among various treatments of row orientations N-S had significantly) more leaf area index (1.51) than E-W direction of wheat sowing. This may be becuse of more availability of sunlight and less over shadowing of adjacent plant canopy.

Tillers count: Bed planting and drilling were at par with each other but significantly better than other treatments. Bed planting gave 7.98 per cent more tillers per square metre than happy seederat harvestmay be due to better edaphic environment and proper uniform distribution of plants.North-south row orientation was significantly better than east-west

Table 1: Effect of different methods of sowing and row orientation on growth attributes of wheat.

Treatments Methods of sowing	Growth attributes of wheat				
	Emergence count (Per meter row length)	Plant height at harvest (cm)	Dry matter accumulation at harvest (qha^{-1})	Leafarea index at 120 DAS	Tillers count at at harvest
Bed planting T_1	32.00	95.42	88.00	3.46	315.66
Zero tillage T_2	31.48	87.82	82.23	3.25	301.80
Flat drilling T_3	31.70	93.19	86.01	3.40	308.82
Happyseeder T_4	31.10	85.03	80.61	3.15	292.32
C.D (0.05)	NS	2.39	2.12	0.14	7.64
Row orientation					
North-south T_5	31.68	91.30	85.31	3.34	307.24
East-west T_6	31.47	89.42	83.12	3.29	302.06
C.D (0.05)	NS	0.50	1.20	0.02	2.89

row orientation and produce 1.71 per cent more tillers per metre square. This may be due to the better utilization of available resources and photosynthetically active radiation.

Number of grains per ear: Higher mean number of grains per ear were achieved in plants sown with bed planting and under north-south row orientation (Kilic, 2010).

Test weight: Test weight under bed planting were 7.41 per cent more than happy seeder. Bed planting was at par with drilling and zero tillagebut significantly better than happy seeder. Wheat sown in north-south row orientation gave 2.05 per cent more 1000 grain weight than sown in east-west row orientation (Hozayn *et al*. 2012).

Grain yield: Different methods of sowing had shown significant effect on the grain yield of wheat crop. . Bed planting and flat drilling methods which were found at par with 41.10q/ha and 39.36 q/ha of grain yield respectively, observed significantly higher grain yield as compare to the crop sown with zero tillage (37.20 q/ha) and happy seeder (36.00 q/ha). Bed planting observed 14.17, 10.48, 4.4, per cent more grain yield as compare to happy seeder which was otherwise the lowest as compare to other methods of wheat sowing. Row orientation also influenced the grain yield significantly, north-south had significantly higher grain yield than east-west. Maximum (39.14 q ha^{-1}) grain yield was under north-south row orientation and minimum (37.70 q ha^{-1}) under east-west row orientation with a difference of 3.86 per cent. This difference was because of better utilization of light and space, thereby improved the growth parameters *viz*. plant height, LAI, dry matter accumulation and development of yield components such as number of effective tillers, number of grains per ear and thus finally increased grain yield.

Straw yield: Higher straw yield was observed with bed planting (48.00 q ha^{-1}) and lowest in case of happy seeder (45.68 q ha^{-1}). There was 5.07 per cent higher straw yield than happy seeder when crop sown under bed planting. Between row orientation north-south produced significantly more than east-west. Maximum (47.74 q ha^{-1}) straw yield was under north-south row orientation and minimum (46.02 q ha^{-1}) under east-west row orientation with a difference of 3.73 per centmay be due to more plant height, LAI, dry matter accumulation and number of tillers.

Harvest index: Among methods of sowing highest harvest index were recorded under bed planting (46.01) followed by flat drilling (45.20), zero tillage (44.64) and happy seeder (44.05). North-south row orientation had harvest index 45.05 whereas east-west row orientation had harvest index value 45.03.

Nitrogen content in grains and straw: Although the bed planting method of wheat sowing gave numerically higher nitrogen content than the other sowing methods of wheat because of better soil conditions and utilization of available resources. Among different row orientations north-south had numerically higher nitrogen content in grains and straw as compare to that of east-west row orientation. This may be because of better harvest of sunlight and better utilisation of photo synthetically active radiations to valuable food.

Protein content in grains: The data regarding protein content of grains was not significantly influenced by different methods of sowing and row orientations. The maximum protein content 10.25 per cent was recorded in bed planting method of sowing. Among row orientations, north-south direction of wheat sown gave numerically higher 10.15 per cent protein content as compare to east-west.

Economics: Economics analysis of different methods of sowing and row orientations was calculated by using cost, returns and net income concepts in Rs. ha^{-1} for year 2015-16. The total cost was categorized into six different categories i.e. land rent, seed bed preparation, labour, harvest labour, seeds, manures and fertilizers. Net income was estimated from total cost by deducting total costs from total returns. Among different methods of sowing, bed planting of wheat gave maximum benefit - cost ratio(1.59) whereas, minimum benefit- cost ratio (1.52) was observed in wheat sown with happy seeder. North-south row orientation gave maximum benefit - cost ratio (1.58) as compare to east-west (1.55).

Table 2: Effect of different methods of sowing and row orientation on yield parameters of wheat.

Treatments Methods of sowing	Yield parameters of wheat				
	Number of grains per year	Test weight	Grain yield (qha^{-1})	Straw yield (qha^{-1})	Harvest index
Bed planting T_1	38.00	35.80	41.10	48.00	46.01
Zero tillage T_2	36.30	33.35	37.20	46.13	44.64
Flat drilling T_3	37.00	35.31	39.36	47.71	45.20
Happyseeder T_4	36.00	33.03	36.00	45.68	44.07
C.D (0.05)	0.68	1.48	2.15	2.02	
Row orientation					
North-south T_5	37.00	34.72	39.14	47.74	45.05
East-west T_6	36.65	34.02	37.70	46.02	45.03
C.D (0.05)	NS	NS	0.88	0.96	

Table 3: Effect of different methods of sowing and row orientation on quality parameters of wheat and economics of study.

	Quality parameters of wheat		Economics	
Treatments Methods of sowing	**Nitrogen content in grains (per cent)**	**Nitrogen content in straw(per cent)**	**Protein content in grains (per cent)**	**Benefit cost ratio**
Bed plantingT_1	1.64	0.52	10.25	1.59
Zero tillage T_2	1.61	0.49	10.06	1.56
Flat drilling T_3	1.62	0.50	10.12	1.57
HappyseederT_4	1.60	0.48	10.00	1.52
C.D (0.05)	NS	NS	NS	
Row orientation				
North-south T_5	1.63	0.51	10.15	1.58
East-west T_6	1.60	0.48	10.06	1.55
C.D (0.05)	NS	NS	NS	

CONCLUSION

In the light of aforementioned results it can be safely concluded that bed planting method of sowing and N-S row orientation is optimal for growth, yield and quality of wheat, because the said sowing method distribute seed uniformly and desired depth for seed germination and crop establishment. Further row orientation and sowing methods provide proper distance for optimum sun light penetration for photosynthesis and proper depth to roots for uptake of water and soil nutrients.

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