Performance of Tillage Practices on Growth and Yield of Different Wheat Varieties under Late Sown Condition

Abstract

The present investigation was conducted to the response of tillage practices on growth and yield of different wheat varieties under late sown condition in rabi season of 2019-20 at Research farm of College of Agriculture, Banda University of Agriculture and Technology, Banda. The experiment was laid out in Split plot Design with three replications. Tillage methods were taken in main plot (Zero tillage and conventional tillage) and five varieties (HI1863, HI 1544, Shriram bioseed 2001, Raj 4120 and K 1317) were taken in sub plots. Results revealed that adoption of zero tillage has recorded maximum emergence count, plant height, dry matter accumulation, tillers/m^2, root length CGR, and RGR, as compared to conventional method of crop establishment. The 10.38 per cent grain yield advantage was recorded with zero till wheat as compared to conventional method. Similarly, 8.2 per cent advantage was recorded in straw yield of wheat as compared to conventional sown wheat. Similar to this, wheat variety K 1317 was produced maximum growth attributingcharacters along with higher yield and b: c ratio.

Key Words: *Growth, practices, tillage, variety, wheat and yield.*

INTRODUCTION

Wheat is the major staple food crop and a major source of energy for Indian population. India has achieved remarkable progress in wheat production during the last 4 decades and is continue to be second largest wheat producing nation in the world. The wheat production has increased manifold from 6.60 million tonnes at the time of independence to 107.18 million tonnes in during 2019-20**(GOI, 2021)**. The major wheat growing states are (Uttar Pradesh, Madhya Pradesh, Punjab, Rajasthan and Haryana) are occupying about 81% of total area under and contributing 83% of total production. Uttar Pradesh has ranks first in both area and production of wheat, however second after Punjab in terms of productivity. To meet the requirement of the burgeoning population, India will need 140 million tonnes of wheat by 2050 AD**.** In order to meet the projected demands the present productivity of wheat has to be raised to the level of 4.30 t/ha, as the possibility of expansion in horizontal direction is remote. A yield gap of 1.5 to 2 t/ha between field demonstrations and what the farmers are harvesting indicates the substantial scope for increase in wheat yields.

Late sown conditions pose challenges for wheat cultivation, impacting tillage practices and yield. Varietal responses to tillage methods differ, affecting growth. Reduced tillage may hinder root development, limiting nutrient uptake. Varied wheat varieties exhibit distinct adaptability, influencing overall productivity. Optimal tillage strategies must be tailored to each variety to enhance late-sown crop performance. The most widely adopted resource conserving technology in the indo Gangetic plane (IGP) has been zero-tillage (ZT) wheat after rice, particularly in India. The present report reviews and synthesizes the experience with ZT in the Indian IGP to better understand and document the impact of this technology and related research. During the early 1990s, with the emerging concern over the sustainability of productivity and growth is increasing rice wheat cropping systems, Zero tillage (ZT) technology plays an important role in the sustainable intensification of rice–wheat cropping system and adoption of better management practices, such as timely crop establishment, in India. Nearly two decades ago, ZT was first introduced to help farmers for reducing tillage costs and advance the planting time of wheat and other *Rabi* crops. In successive years, ZT marked the evolution of the concept of conservation agriculture in rice–wheat cropping systems. ZT now offers significant opportunities in cropping system optimization for greater system productivity, especially in the eastern Indo-Gangetic Plains of India. As the majority of farmers in rice–wheat cropping systems still burn the residues of the rice crop to enable their rapid disposal before wheat sowing, recent advances in ZT makes it possible to sow wheat successfully with residues and facilitate the use of residues as mulches for weed suppression and moisture conservation. Many successful examples and resource conservation technologies adopted in other part of country, this technology may be boon for early sowing and reducing cost of cultivation in rice based ecology of Bundelkhand region without any adverse effect on crop establishment. Sustainably enhancing wheat productivity in the Bundelkhand region is vital for ensuring future food security. While in controlled field trials of zero-tillage (ZT) wheat has demonstrated considerable yield benefits, empirical assessments of the performance stability of the practice in farmers' fields of Bundelkhand regions are lacking. The spread of conservation agriculture (Zero till) demands suitable wheat varieties which are capable of maintaining satisfactory yields with lower inputs and tolerates the thermal heat stress during grain filling stages. Some new varieties of wheat developed by agricultural universities and private companies are available in market and farmers using of theses varieties but there behavior and ability in conservation agriculture system are not assessed at wider level.

The Bundelkhand region is not a traditional wheat growing area, it is known for pulse and oilseed. However, in low lands and other part farmers are practicing wheat and now it is dominant crop of the region. The high yielding rice varieties are mostly long duration, when harvest in December normally, which cause delay in sowing of wheat.Soil moisture is the most limiting factor for crop cultivation in Bundelkhand, as usual as dry land. Further excess moisture and several other reasons are also responsible for the late sowing. The yield of wheat crop decreases under late sown condition. The tillage practices particular zero tillage provides the opportunity by saving of primary tillage time to sow the crop early further varieties have also potential to mitigate the effect of late sowing and have ability to produce good yield under late sown.The objective is to assess the impact of various tillage practices on the growth and yield of diverse wheat varieties under late sown conditions. By examining the interaction between tillage methods and wheat varieties, this study aims to provide valuable insights into optimizing agricultural practices for late-sown wheat cultivation. The findings will contribute to enhancing crop productivity and sustainability in challenging growing conditions, ultimately supporting informed decision-making for farmers and agricultural stakeholders.

MATERIALS AND METHODS

The experiment was conducted at Agricultural Farm of Banda University of Agriculture & Technology, Banda during the *Rabi* season 2019- 20, which is situated in Bundelkhand part of Uttar Pradesh and lies between 25^0 53′ North latitude and 80^0 34′ East longitude at an elevation of 123 meters from the sea level. This region falls under agro climatic zone VIII (Central Plateaus & Hills Region) of Uttar Pradesh The mean maximum temperature throughout the growing season was 34.36 °C, while the mean lowest temperature was 10.2 °C, according to meteorological data. Minimum 44% and maximum 50.6% were reported for the mean relative humidity. The pan evaporation was found to range between 2.1 mm and 5.1 mm in thickness. The average wind speed for the experiment was 4.3 km/h. Three wet days totaling 27.9 mm fell on the trail location during the trial period. However, the 364.5 mm of total evapotranspiration created ideal circumstances for crop development. Initial results of the field experiment on soil fertility showed soil pH at 7.3, organic carbon at 0.42 percent, available nitrogen at 212 kg/ha, available phosphorus at 8.95 kg/ha, and available potassium at 219 kg/ha. The experiment was laid out in split plot design with three replications. The treatments were consisting of two tillage methods as main plot treatments viz., T_1-Conventional tillage and T_2- Zero tillage with five wheat varieties in sub plot treatments viz., V_1- HI 1544, V_2 –HI 1563, V_3- Shriram bioseed 2001, V_4- Raj 4120 and V_5- K 1317.

The ZT consisted minimum soil disturbance, which accompanied by just opening a narrow furrow, putting the seeds into furrow and covering the seeds in one operation, The conventional tillage consisted of one deep ploughing, followed by two passes of cultivator with planking in the last pass. A solution of Glyphosate (3.5 litter/ha) was applied in the zero tillage treatment plots to control existing weeds before sowing of the crops. Certified seed of the wheat varieties was sown in at a distance of 20 cm with the help of tractor drawn seed drill and 100 kg seed ha^{-1} was used. The recommended dose of NPK was taken as 100: 60: 60 kg ha^{-1} of N, P_2O_5 and K_2O repetitively in late sown. Nitrogen, phosphorus and potassium were given through urea

(46% N), DAP (18 % N & 46% P_2O_5) and MOP (60% K_2O) respectively. Total amount of DAP, MOP and 50% of nitrogen were applied at time of sowing and remaining half of nitrogen was top dressed in two equal splits at CRI and tillering stages. The crop was infested with grassy and broad leave weeds and that was controlled by herbicide ready mix combination of (clodinofop + MSM) as per recommended dose with using 375 litter/ha. In general, wheat crop needs irrigation (6) at CRI (20-25 DAS), late tillering (40-45 DAS), late jointing (60-65 DAS), booting/flowering (80-85 DAS), milking (90-95 DAS) and dough stages (110-115 DAS). In our study three irrigation was applied at CRI stage (13/01/2020), late tillering stage (01/02/2020) and flowering stage (17/03/2020).

All the growth and yield attributing characters were recorded with the standard methodology at different growth stages of the crop. Various growth indices were estimated with the formulae as per mentioned below

Crop Growth Rate (g m^{-2} day^{-1})

$$CGR = \frac{\mathrm{W2} - \mathrm{W1}}{\mathrm{t2} - \mathrm{t1}} \times \frac{1}{\mathrm{A}}$$

Where,

W_1 = Dry weight of plant (g) per m row length at time t_1

W_2 = Dry weight of plant (g) per m row length at time t_2

A = Land area (cm^2)

Relative Growth Rate(RGR) (g.g^{-1}.day^{-1})

$$RGR = \frac{\mathrm{logeW2} - \mathrm{logeW1}}{\mathrm{t2} - \mathrm{t1}}$$

Where; W_1 = Dry weight of plant (g) per m row length at time t_1

W_2 = Dry weight of plant (g) per m row length at time t_2

HarvestIndex (%)

$$HI = \frac{\text{Economic yield (kg ha}-1)}{\text{Biological yield (kg ha}-1)} \times 100$$

Where, Economic yield = seed yield (Kgha-1); Biological yield = seed yield + straw yield (kg ha-1)

Recorded data was analyzed using appropriate method of 'Analysis of Variance (ANOVA)' given by **Gomez and Gomez (1984).**

RESULTS AND DISCUSSION

Performance of treatments on growth attributing characters.

Zero tillage adoption resulted in a significantly higher maximum emergence count (65.7/m^2) than the conventional method (62.9/m^2) of crop establishment. Variety RAJ 4120 had the highest germination count, which was followed by K1317, which was on par with Shriram bioseed 2001, and HI 1563, which had much higher germination counts than HI 1544. Their genetic variety may explain variations in germination rate. These outcomes are consistent with (Poudel *et al.,* 2020 and Mavi *et al.,* 2020). At maturity, only varieties had a significant impact on the effect of various tillage techniques and plant kinds on plant height. Maximum plant height of wheat was observed with K1317 followed by Raj 4120 and significantly higher over other varieties. Theses varieties performed better in terms of growth adopted very well in late sown condition and tolerates high temperature during growth might be responsible for attaining higher plant height (Vashisth *et al*., 2020 and Koushik *et al.*, 2020). With the use of zero tillage, the number of tillers considerably rose. Raj 4120, followed by K1317, produced the most tillers among the types, on par with Shriram bioseed 2001 and much more than HI1563 and HI 1544. When compared to wheat grown using the traditional approach, adoption of zero till wheat revealed a noticeably higher dry matter accumulation. All kinds are severely impacted by tillage techniques, and all types are impacted to the same degree. Raj 4120 generated the highest dry matter accumulation with no tillage, followed by K1317. The maximum root length for a wheat crop grown under zero tillage conditions was 19.0 cm, whereas conventional wheat at the tillering stage measured 16.7 cm. This difference may be explained by the fact that the zero tillage conditions had finer roots and a higher root density, as well as a continuous supply of moisture to the crop. In conventional tillage, a greater volume of soil was tilled, and when there was a moisture deficit in the soil, crops suffered because of hard pans in the subsoil, which may have contributed to relatively shorter root length. Difference in resistance to bulkling may be more important than any difference in root elongation rate once a root reaches the strong soil (Alam *et al*., 2014). Among varieties significantly maximum and minimum values of root length were recorded with K 1317 and HI 1563 respectively. The interaction effect between tillage methods and varieties was significant**.** Shriram bioseed 2001 recorded maximum value of root length at tillering stage in zero tillage, while minimum value of root length was recorded with HI 1544 in conventional tillage (Table.1).

Performance of treatments on CGR and RGR.

Crop grown with zero till condition recorded the higher values of CGR are 7.12**,** 16.7 and 3.02 at 30-60, 60-90 and 90 to maturity, respectively(Table.2). Similarly, RGR at different crop growth stages was recorded maximum with Zero till 0.025, 0.019 and 0.002 values at 30-60, 60-90 and 90 to maturity, respectively. No disturbance of soil in form of zero tillage has favorable effects on soil properties and moisture availability in soil which reflects the yield attributing characters and yield. Similar results was reported by (Phogat *et al*., 2020 and Khalid *et al.*, 2014).Among the varieties of wheat, the maximum and minimum values of CGR and RGR were recorded with K 1317 and HI 1544 respectively at all stages it, may be responsible for higher yield. Similar finding were observed by (Mishra andsingh 2012 and Mitra *et al.,* 2014).

Performance of treatments on yield of wheat.

The zero till wheat produced 10.38 per cent yield advantage as compared to conventional method of tillage adopted. Similarly, 8.2 percent higher stray yield was observed under zero till conditions as compared to conventional tillage(Table.3). The yield advantage in zero till condition is the result of better growth parameter and yield attributing characters were recorded with zero till condition. Another important advantage was noticed that crop matures about 10 days delay in zero till condition which reflects the diversion of phosynthates into economic yield. Zero till wheat gave highest gross return of Rs.95799/ha, net return (Rs 60509) and B:C ratio as compared to conventional sown wheat due to less cost of cultivation involved in zero till condition. Similar findings was reported by (Tripathi *et al.,* 2013 and Khatri *et al.,* 2013).The higher values of grain yield of wheat were recorded with K 1317 and minimum with HI 1563. However, the difference was not significant between the varieties in relation to grain, straw and biological yield obtained per hectare of wheat. Similarly, harvest index also not affected significantly due to different varieties used in study. The non significant difference in varieties might be due to the force maturity of wheat and no difference was observed in duration of maturity in late sown condition. Similar finding was reported by (Singh *et al.,* 2013).

CONCLUSION

Results exhibited that zero tillage has positive impact on growth, yield attributes and yield of wheat crop irrespective of varieties as compared to conventional tillage. Similar to this, wheat variety K 1317 outperforms other types in terms of growth.In late-sown conditions, adopt conservation tillage practices to enhance soil moisture retention and reduce evaporation. Choose wheat varieties with shorter growth durations, improved stress tolerance and higher yield potential. Implementing these strategies can optimize growth and yield outcomes for wheat crops in challenging late-sown environments.

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Table 1:Effect of treatments on growth attributing characters.

Treatments	Emergence count /m^2 at 20 DAS	Plant height (cm) at maturity	Number of tillers/m^2 at maturity	Dry matter accumulation (g/m^2) at maturity	Root length (cm)
Tillage methods (T)					
Conventional tillage	62.8	104.8	295.0	780.1	16.7
Zero tillage	65.7	107.9	308.4	854.3	19.0
SEm±	0.22	0.93	0.37	5.0	0.27
C.D. at 5%	1.44	NS	2.45	33.0	1.80
Varieties (V)					
HI 1544	63.4	105.8	295.6	809.1	17.30
HI 1563	64.0	106.3	299.3	787.6	17.26
Shriram bioseed 2001	64.2	105.8	303.1	825.9	18.06
Raj 4120	65.2	106.2	305.5	818.5	18.30
K 1317	64.5	107.9	305.1	844.1	18.33
SEm±	0.37	0.40	0.28	22.31	0.29
C.D. at 5%	1.14	1.23	0.87	NS	0.88

Table 2: Effect of treatments on growth indices.

Treatments	CGR (g m -2 day -1)			RGR(g g -1 day -1)		
	30-60 DAS	60-90 DAS	90 DAS-Maturity	30-60 DAS	60-90 DAS	90 DAS-Maturity
Tillage methods(T)						
Conventional tillage	6.55	15.83	2.13	0.022	0.020	0.001
Zero tillage	7.12	16.77	3.02	0.025	0.019	0.002
SEm±	0.02	0.11	0.22	0.000	0.000	0.000
C.D. at 5%	0.17	0.75	NS	0.003	NS	NS
Varieties(V)						
HI 1544	6.66	16.05	2.76	0.022	0.020	0.002
HI 1563	6.71	16.12	1.91	0.022	0.020	0.001
Shriram bioseed 2001	6.92	16.58	2.55	0.025	0.020	0.001
Raj 4120	6.85	16.27	2.61	0.023	0.018	0.002
K 1317	7.04	16.48	3.09	0.027	0.020	0.002
SEm±	0.05	0.12	0.66	0.002	0.001	0.000
C.D. at 5%	0.17	0.37	NS	NS	NS	NS

Table 3: Effect of treatments on yield.

Treatments	Grain yield	Straw yield	Biological yield	Harvest index(%)
Tillage methods				
Conventional tillage	33.73	44.26	78.03	43.10
Zero tillage	37.25	48.19	85.44	43.60
SEm±	0.22	0.19	0.38	0
C.D. at 5%	1.44	1.28	2.53	0.002
Varieties				
HI 1544	35.16	45.83	81.00	43.70
HI 1563	34.23	44.55	78.79	42.10
Shriram bioseed 2001	35.50	47.10	82.60	43.80
Raj 4120	35.66	46.23	81.90	44.20
K 1317	37.00	47.41	84.41	42.80
SEm±	1.31	1.02	2.31	0.013
C.D. at 5%	NS	NS	NS	NS

Abbreviation NS- Non significant