Effect of different tillage practices and summer green manuring on growth indices of wheat under irrigated condition of Eastern Uttar Pradesh

Sunil Kumar, RN Meena, Tej Ram Banjara, Vikram Kumar, K Hemalatha, Hari Singh, Sandeep Kumar and Sanjeev Kumar Kashyap

Abstract
The field experiment was undertaken at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during kharif and rabi season of 2016-17 and 2017-18 to evaluate the effect of summer green manuring with adoption of different tillage practices on growth indices of wheat crops under irrigated condition of Eastern Uttar Pradesh. The field experiment was laid-out in split plot design with three replications. The treatment comprised of four tillage practices in main plot viz., T1 (CTM-CTW), T2 (MTC-CTW), T3 (MTM-CTW), T4 (ZTM-ZTW) and five summer green manuring in sub plot viz., M1 (summer following), M2 (Dhaincha (Sesbania aculeata)), M3 -Sunhemp (Crotalaria juncea), M4 (Clusterbean (Cyanopsis tetragonoloba)), M5 - Cowpea (Vigna sinensis) were investigated. The result revealed that the crop growth rate of wheat was significantly influenced by tillage practices and summer green manuring during both the years. However, relative growth rate was not significantly affected during both the years of investigation. Among the tillage practices the significantly highest crop growth rate (g/m²/day) was recorded in T4-ZTW (0.389, 0.398, 0.925, 0.962, 4.714, 4.704, 1.914, 1.967 at 30, 60, 90 DAS and at harvest, respectively in both years) at all the stage of observation during both the years but it was found statistically at par with T1-(CTM-CTW). Among the summer green manuring practices, crop growth rate was significantly highest in M2 -Dhaincha (Sesbania aculeata) (0.389, 0.397, 0.921, 0.952, 4.728, 4.701, 1.943, 2.016 at 30, 60, 90 DAS and at harvest, respectively in both years) but it was statistically at par with M3-Sunhemp (Crotalaria juncea) at all the growth stages of wheat during both the years. In conclusion, zero tillage wheat with dhaincha or sunhemp was the best practice for the cultivation of wheat under irrigated conditions of Eastern Uttar Pradesh.

Keywords: tillage, summer green manuring, crop growth rate, relative growth rate

Introduction
Rice-wheat (RW) cropping system is one of the world's largest agricultural production systems, covering an area of 26 million hectares spread over the Indo-Gangetic Plains (IGP) in South Asia and China (Chauhan et al. 2012) [9]. The IGP region of India has RWCS spread over a vast area spanning from Punjab in the Northwest to East up to West Bengal (Singh et al. 2005) [18]. Sustainability of RW system has been questioned with yield stagnation, declining underground water table (Humphreys et al. 2010) [13], unattended intervening periods (Bhatt and Kukal, 2015) [4, 5], soil degradation and atmospheric pollution. The intensive adoption of rice-wheat cropping system following conventional tillage practices has led to deterioration in soil health and reducing the profitability of crops by reducing the yields. Maize-wheat cropping system occupies fifth place in IGP of India (Yadav and Subba Rao, 2000). Maize could be a substitute for the rice growing farmers with adoption of conservation agriculture system. Tillage costs the second costliest monetary input after fertilizer for wheat production. Conservation tillage systems improve land productivity by way of improved soil physical properties, reduced soil loss and enhanced soil organic C (Lal, 2004) [15]. With respect to yield, conservation tillage practices were better than/or equally good to the conventional till (CT) practices in studies on Upland cotton cultivars at Nagpur, India (Blaise and Ravidrnan, 2003; Blaise, 2006) [7, 6], on irrigated Vertosols of Australia (Hulugalle et al. 2004) [12] and in the USA (Boquet et al. 2004) [8]. Besides these advantages, input costs are lowered by way of eliminating a series of tillage operations (Hobbs, 2007) [11]. There is a growing interest towards the use of conservation management systems, such as reduced-tillage, no-tillage, crop residue addition, and improved nutrient management practices in rice and other crops in rotation for sustainably increasing food production in South Asia (Johnston et al. 2009) [14]. The importance of leguminous green manure crops in improving soil fertility and soil physical properties has received increasing attention in recent times.
The improvement in soil physical conditions as a result of buildup of organic matter by incorporation of green manure or crop residue is associated with a decrease in bulk density, increase in total pore space, water stable aggregates and hydraulic conductivity of the soil (Bhatnagar et al. 1992) [3]. Hence, different conservation tillage methods are adopted as alternative to conventional tillage to overcome food, fodder, soil and water problems. In view of the difficulties in traditional method of growing of these crops and by considering the several benefits of conservation tillage practices as economic benefits by labour, a substantial saving in time and cost, erosion protection, soil and water conservation, and increase in soil organic matter; present experiment was conducted to evaluate the feasibility of different tillage practices with summer green manuring to sustain crop growth, productivity and soil health in maize-wheat cropping sequence under irrigated condition of Eastern Uttar Pradesh.

**Material and Methods**

The field experiment was undertaken at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during kharif and Raib season of 2016-17 and 2017-18. Geographically, BHU, Varanasi is situated at (25°18' N, 83° 31'E and altitude of 75.7 m mean sea level) and receiving average annual rainfall of 1,100 mm in the northern Indo-gangetic alluvial plains. The soil was sandy clay loam, with pH 7.72 and electrical conductivity (EC) 0.30 dS/m, low in organic carbon (0.41%), available N (146 kg/ha), and medium in available (0.5 M sodium bicarbonate extracted) phosphorus (18.3 kg/ha) and potassium (175 kg/ha, 1 N ammonium acetate extracted). The field experiment was laid-out in split plot design with three replications. The treatment comprised of four tillage practices in main plot viz., T1 (Conventional tillage maize-Convention tillage wheat), T2 (Minimum tillage maize-Minimum tillage wheat), T3 (Minimum tillage maize-Zero tillage wheat), T4 (Zero tillage maize-Zero tillage wheat) and five summer green manuring in sub plot viz., M1 (Summer fallowing), M2 (Dhaincha (Sesbania aculeata)), M3 -Sunn hemp (Crotalaria juncea), M4 Clusterbean (Cyamopsis tetragonoloba), M5 - Cowpea (Vigna sinensis) were investigated.

The recommended package and practices were followed properly for growing crop in the field condition. Dry matter of maize was recorded on four point (25 cm row length) from border was selected. After oven drying the samples at 70°C average was taken and expressed in terms of dry matter accumulation (g row length\(^{-1}\)). CGR and RGR were calculated by using the formulae described by Radford (1967) [10].

\[
\text{CGR (gm}^2\text{day}^{-1}) = \frac{W_2-W_1}{t_2-t_1} \\
\text{RGR (g gm}^{-1}\text{day}^{-1}) = \frac{\text{Ln } W_2-\text{Ln } W_1}{t_2-t_1}
\]

Where, \(W_2-W_1\)=Difference in oven dry biomass at the interval, \(t_2-t_1\)= time interval in days and \(\text{Ln } W_1\) and \(\text{Ln } W_2\) are the natural logarithm of total dry weight of plant at the time interval \(t_2\) and \(t_1\) respectively.

The data recorded for different characters under investigation were analyzed by following analysis of variance procedure as described by Gomez and Gomez (1984) [10].

**Result and Discussion**

Crop growth rate was computed at 30, 60 and 90 DAS and at harvest. The perusal of data given in Table 1 and Fig.1 revealed that the tillage practices and summer green manuring significantly influenced CGR in both the year. Among different tillage practices significantly highest crop growth rate was recorded in T4 (ZTM-ZTW) at all the stage of observation during both the years. But it was found statistically at par with treatment T1-Convention tillage maize-Convention tillage wheat. Crop growth rate was increase up to 90 DAS thereafter decrease might be due to lower accumulation rate dry matter in plants at later stage. These results are in close conformity with the findings of Banjara et al. (2015) [2] they were observed significantly highest crop growth rate of linseed under zero tillage direct drilling of seeds and fertilizers 2\(^{nd}\) day after harvest of rice under rainfed condition.

Among the summer green manuring crop growth rate was significantly highest in M\(_2\) dhaincha but it was found at par with M\(_3\) -sunnhemp at all the stage of observation during both the years of study.

Relative growth rate of wheat was computed at 30-60, 60-90 DAS and 90 DAS to at harvest stage illustrated in Table 2 and Fig. 2. The relative growth rate was decreases with increases in growth stage of crop and it was observed that tillage practices and summer green manuring has no significant influence on relative growth rate of crops but the higher numerical value was observed with tillage practice and summer green manuring of T4 (ZTM-ZTW) and M\(_2\) dhaincha, respectively during both the years of study.

The different growth parameters, viz. CGR and RGR of wheat was influenced significantly due to tillage practices and summer green manuring during both the years of study. The growth parameters of wheat was significantly higher under zero till wheat, this might be due to better root growth (Aggarwal et al. 2006) [1], which might helped in better soil moisture extraction during dry periods and maintained the plant vigour. Similarly, residue retention of summer green manure of dhaincha significantly improved the all the growth parameters than other treatments under different tillage practices, this might be due to residue application improve the physical environment in the soil; more available soil moisture and nutrients, moderate the soil temperature and reduce the evaporation losses from surface soil. Ram (2006) [17] also reported the higher values of CGR and RGR under permanent bed with residue than no-residue under both ZT and CT practices. The similar results were also reported by (Tolk et al. 1999) [19]. The growth parameters were marginally higher under ZT practice, this might be due to better soil health and micro-environment created by continuous adoption of these environment friendly and resource conserving practices. Yadav et al. (2005) also reported marginally higher growth parameters under ZT than CT.

**Table 1**: Tillage practices and summer green manuring influenced on crop growth rate of wheat

<table>
<thead>
<tr>
<th>Treatment</th>
<th>30 DAS</th>
<th>60 DAS</th>
<th>90 DAS</th>
<th>At harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I Year</td>
<td>II Year</td>
<td>I Year</td>
<td>II Year</td>
</tr>
<tr>
<td>T1(CTM-CTW)</td>
<td>0.382</td>
<td>0.389</td>
<td>0.861</td>
<td>0.879</td>
</tr>
<tr>
<td>T2(MTM-MTW)</td>
<td>0.365</td>
<td>0.373</td>
<td>0.835</td>
<td>0.846</td>
</tr>
</tbody>
</table>
Conclusion
The tillage practices affects crop growth rate, the higher value was recorded in zero till wheat at all the stage of observation during both the years but it was also found statistically at par with conventional till wheat. Among the summer green manuring practices, crop growth rate was significantly highest in dhaincha and it was also comparable with sunnhemp during both the years. In conclusion, zero tillage wheat with dhaincha or sunhemp summer green manuring was the best.

Fig 1: Tillage practices and summer green manuring influenced on crop growth rate of wheat at different intervals during 1st and 2nd year

Table 2: Tillage practices and summer green manuring influenced on relative growth rate of wheat

<table>
<thead>
<tr>
<th>Treatment</th>
<th>30-60 DAS</th>
<th>60-90 DAS</th>
<th>90 DAS - At harvest</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I Year</td>
<td>II Year</td>
<td>I Year</td>
</tr>
<tr>
<td>T1(CTM-CTW)</td>
<td>0.01705</td>
<td>0.01708</td>
<td>0.02242</td>
</tr>
<tr>
<td>T2(MTM-MTW)</td>
<td>0.01722</td>
<td>0.01714</td>
<td>0.02231</td>
</tr>
<tr>
<td>T3(MTM-ZTW)</td>
<td>0.01740</td>
<td>0.01755</td>
<td>0.02235</td>
</tr>
<tr>
<td>T4(ZTM-ZTW)</td>
<td>0.01720</td>
<td>0.01725</td>
<td>0.02222</td>
</tr>
<tr>
<td>S. Em ±</td>
<td>0.00040</td>
<td>0.00047</td>
<td>0.00030</td>
</tr>
<tr>
<td>CD (p=0.05)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
<tr>
<td>M1(Summer fallowing)</td>
<td>0.01719</td>
<td>0.01721</td>
<td>0.02242</td>
</tr>
<tr>
<td>M2(Dhaincha)</td>
<td>0.01747</td>
<td>0.01762</td>
<td>0.02216</td>
</tr>
<tr>
<td>M3(Sunhemp)</td>
<td>0.01744</td>
<td>0.01748</td>
<td>0.02201</td>
</tr>
<tr>
<td>M4(Clusterbean)</td>
<td>0.01714</td>
<td>0.01711</td>
<td>0.02237</td>
</tr>
<tr>
<td>M5(Cowpea)</td>
<td>0.01685</td>
<td>0.01685</td>
<td>0.02266</td>
</tr>
<tr>
<td>SEm±</td>
<td>0.00035</td>
<td>0.00039</td>
<td>0.00028</td>
</tr>
<tr>
<td>CD (p=0.05)</td>
<td>NS</td>
<td>NS</td>
<td>NS</td>
</tr>
</tbody>
</table>

Fig 2: Tillage practices and summer green manuring influenced on relative growth rate of wheat at different intervals during 1st and 2nd year
practice for cultivation of wheat under irrigated conditions of Eastern Uttar Pradesh.

References


