ENHANCING SUSTAINABILITY IN WHEAT PRODUCTION THOUGH IRRIGATION REGIMES AND WEED MANAGEMENT PRACTICES IN EASTERN UTTAR PRADESH

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KEYWORDS

Irrigation regimes
Herbicides
Weeds
Wheat yield
A field experiment was conducted during the winter (rabi) seasons of 2012-13 at Varanasi, enhancing sustainability in wheat production though irrigation regimes and weed management practices in eastern Uttar Pradesh. Weed density and biomass increased significantly with the increase in irrigation levels (regimes) from 80 mm CPE to 40 mm CPE. Significantly the highest density and dry weight of weeds, growth parameters, grain (5.06 tonnes/ha), straw and biological yield was recorded with the application of irrigation at 40 mm CPE. The grain yield was 18.6% and 27.7% higher under 40 mm CPE over irrigation at 60 mm CPE and 80 mm CPE, respectively. Application of sulfosulfuron reduced weed population and biomass significantly, thereby caused increase in plant height (0.88%), crop dry matter (8.8%), tillers (3.1%) and leaves/running meters (2.8%), resulted in significantly the highest grain (4.72 tonnes/ha) and metsulfuron methyl. The grain yield was 13.6% and 4.7% higher under sulfosulfuron over metribuzin and metsulfuron methyl, respectively. For the enhancing of sustainability in wheat production, it will be irrigated at 40mm CPE and weeds are managed by the post-emergence application of sulfosulfuron 25 g/ha.

ABSTRACT

INTRODUCTION

Wheat (Triticum aestivum L. emend. Fiori and Paol.) is an important cereal crop of cool environment and is gaining popularity all over the world and especially in India (Sinha et al., 2011). Due to increase in population and food prices, higher yield of the wheat can play a vital role in stabilizing the food prices directly or indirectly. Management of many factors can significantly contribute in increasing the grain yield of wheat in the country. Among these factors, irrigation and weed management are important factor and can increase the wheat yield if managed successfully in the traditional as well as non-traditional area of the country (Khan et al., 2007; Arya et al., 2013). Rice-wheat is the predominant cropping system in this region, but declining factor productivity and over exploitation of groundwater resources due to faulty irrigation practices followed by the farmers, has necessitated in exploring alternate options of managing water for sustainable crop production. The goal of efficient water management is to increase crop water use efficiency by reducing the amount of water in irrigation or by reducing the number of irrigation events, in that way we will sustain the crop production in future also (Kirda, 2002).

Appropriate management of irrigation water is the key to reap full benefit from all other resources/inputs. Application of irrigation based on available soil moisture or on climatic approach has been found more appropriate for getting higher economic return, water productivity and nutrient use efficiency (Jat et al., 2008). Weeds are an important obstacle to crop production, particularly in low-input and intensive agriculture systems (Sharma, 2014). Weeds are notorious, causing several health disorders, environmental pollution, decreasing the aesthetic value of land, obstacle in aquatic life, mining-off huge quantity of water and nutrients from the soil, crop yield reducers that are, in many situations, economically more important than insects, fungi or other pest organisms (Verma et al., 2008; Gupta et al., 2013 and Singh, 2014). At present weed management approaches used in country are mostly dependent largely on herbicide application or manual weeding after critical period of weed competition and thus resources are wasted without any significant yield advantage. Weeds are not dying after a critical period and herbicide remain as such present into the soil, which will reach to the ground water through leaching and in water bodies through land degradation, causing several types of health related problems in human, animals and on the aquatic environment. However due to ignorance and lack of knowledge the farmers blindly apply herbicides without considering its time and dose of herbicide application, results poor weed control and ultimately they get lower yield of crop (Singh et al., 2013).

Weeds can be suppressed in wheat through variety of techniques as single method of weed control is not sustainable in our country. As crop-weed interference is inevitable therefore a judicious use of herbicides and integration of other methods may prove more effective. Chemical weed management should be relied upon as the sole method of protecting crops from weeds in irrigated as well as in rainfed conditions. Because the unavailability of labour dependency on herbicides for weed control will be increased. Herbicides should be used at right time with right dose and methods gives satisfactory weed control. Under the conditions of irrigation,
with an improvement in the irrigation amount, the yield of wheat was increased (Quanqi et al., 2008). Wheat production systems are already at risk due to other problems viz., ground water depletion, heavy incidence of weeds, water logging and salinity, deteriorating soil physical conditions and declining soil organic matter content etc (Nasrullah et al., 2010 and Singh et al., 2013). Keeping in view the above findings led to the plan to plant the wheat by conventional sowing methods. Under the present study, different irrigation regimes and weed management practices were tried for sustaining wheat production. The main objective was to find out the most effective irrigation regimes and weed management practices for the sustained wheat production and secondly to judge the effective irrigation regimes and weed management practices on weeds.

**MATERIAL AND METHODS**

The field experiment was conducted during winter (rabi) season of 2012-13 at Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi (25°18’ – N L, 83°03’ – E L and altitude of 129 m above mean sea level). The soil of experimental site is sandy clay loam, slightly alkaline (pH7.8, Jackson, 1967) in reaction and moderately fertile being low in organic carbon (0.45%, Walkley and Black, 1934) and available nitrogen (240 kg N/ha, Subbiah and Asija, 1956) and medium in available phosphorus (25 kg P/ha, Jackson, 1973) and potassium (225 kg K/ha, Prasad, 1982). The experiment had 15 treatment combinations of three irrigation regimes, viz. 40 mm, 60 mm and 80 mm CPE (cumulative pan evaporation) in main plot and five weed control practices, viz. weedy check, weed free (HW at 20 and 40 DAS), sulfoisufuron 25 g/ha post-emergence, metribuzin 210 g/ha post-emergence and metsulfuron-methyl 6 g/ha post-emergence in sub plot. These were evaluated under split-plot design with three replications. The wheat variety ‘HUW 234’ was sown on 1st December 2012 with the help of ferti-seed drill at 22.5 cm row spacing using 100 kg seed/ha in 4.6 x 5.5m² gross plot size. As per the treatment, 6cm water was applied per irrigation by fixing Parshal flume in irrigation channel. CPE was worked out from the daily Epan data taken from I. Ag. Sc., BHU observatory. All the herbicides were applied with the help of flat fan nozzle attached to the foot sprayer using volume of spray 500 litters/ha, at 32 days after sowing. Urea, diammonium phosphate and muriate of potash were used as sources of nitrogen, phosphorus and potassium, respectively. An uniform dose of 40 kg N + 60 kg P + 40 kg K/ha was applied uniformly at the time of sowing and remaining 80 kg N was top-dressed in two equal splits, each at after first irrigation and flowering time. All the general crop management practices were followed to success the crops. Data on weed was recorded from an area enclosed in the quadrat of 0.25/ m² randomly selected at three places in each plot. Oven dry weight of weeds was recorded at 70°C for 48hr. and expressed as dry matter g/m² (Mani et al., 1968). Data on growth parameters, grain, straw and biological yield at harvest were studied. The crop was harvested on 8th April 2013. The total rainfall received during the crop season was 86.8 mm, distributed in7, 8 and 11th weeks, respectively. The data on weeds, grain yield (kg ha⁻¹) and straw yield (kg ha⁻¹) were compiled and analyzed statistically as per the standard analysis of variance to draw valid conclusions (Gomez and Gomez, 1984). The treatment differences were tested by ‘F’ test of significance on the basis of null hypothesis. Critical differences were worked out at 5 per cent level of probability where ‘F’ test was significant. The mean density and biomass of weeds were square root transformed to normalize the count data and subsequent analysis is done.

**RESULT AND DISCUSSION**

**Density and dry weight of weeds**

Density and dry weight of weeds significantly affected by irrigation regimes and weed management practices (Table 1). Significantly the lowest density and dry weight of weed was recorded with application of irrigation at 80mm CPE over 60 mm CPE and 40 mm CPE, respectively. The decrease in density and dry weight of weeds at lower rate of irrigation resulted from the least availability of moisture, which provides inadequate growing environment to weeds. Optimum time and number of irrigation reduces the density and weight of weeds (Das and Yaduraju, 2007). Singh and Singh (2004) reported that pre-sowing irrigation reduced the dry weight of Chenopodium album and Chenopodium murale by 21 and 25%, respectively, and subsequently grain yield was 12% higher over post sowing irrigation. Wheat irrigated at CRI+tillering+flowering stage reduced the dry weight of Phalaris minor over crop irrigated at CRI+tillering +flowering+ dough, CRI+tillering, CRI+flowering and at CRI stage, respectively (Das and Yaduraju, 2007). Among herbicidal treatments, application of sulfoisufuron recorded significantly lowest density and dry weight of weeds than metribuzin and it was at par with metsulfuron-methyl. These results are corroborated with findings of Arora et al. (2013) and Upasni et al. (2013). Superiority of sulfoisufuron in reducing the density and dry weight of weeds than metribuzin and metsulfuron-methyl also reported by Singh et al. (2013) and Singh et al. (2013). However, two hands weeding at 20 and 40 DAS (weed free) was found more effective than the herbicides, due to slow pace of growth of first flush of weeds, 20 days after sowing thereafter the emergence of new flushes of weeds could not attain full growth under the shade of crop plants. These results are in close conformity with those of Bharat and Kachroo (2007). Verma et al. (2008) and Singh et al. (2013) reported the superiority of hand weeding over herbicidal treatments. Faisal et al. (2012) reported that the lowest weed biomass under hand weeded plots followed by herbicidal treatments. Significantly lowest density and dry weight of narrow and broad leaf weeds was recorded with the post-emergence application of metsulfuron (6 g/ha) reported by Singh et al. (2013).

**Crop growth and yield**

Irrigation at 40 mm CPE resulted into significantly the highest plant height, tiller/running meter, leaves, crop dry weight, grain, straw and biological yield followed by irrigation at 60 mm and at 80 mm CPE, respectively (Table 1). The better development of crop under irrigated treatments was a result of better moisture availability, which maintained the internal water balance of the plant. Increase in grain and straw yield of wheat is due to the increase in the yield attributes as reported by Khan et al.
Table 1: Effect of irrigation regimes and weed management practices on weeds and yield of wheat

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Weed density (m²)</th>
<th>Weed dry weight (g/m²)</th>
<th>Plant height at 40 DAS</th>
<th>Tillers/running meter at 40DAS</th>
<th>Green leaves/running meter at 40DAS</th>
<th>Crop dry weight at 40 DAS (g)</th>
<th>Grain yield (t/ha)</th>
<th>Straw yield (t/ha)</th>
<th>Biological yield (t/ha)</th>
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</thead>
<tbody>
<tr>
<td><strong>Irrigation regimes</strong></td>
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<tr>
<td>(I1) 40 mm CPE</td>
<td>35.0</td>
<td>7.38</td>
<td>34.7</td>
<td>92.3</td>
<td>229.7</td>
<td>21.5</td>
<td>5.06</td>
<td>8.40</td>
<td>13.46</td>
</tr>
<tr>
<td>(I2) 60 mm CPE</td>
<td>33.4</td>
<td>6.78</td>
<td>34.1</td>
<td>90.5</td>
<td>231.3</td>
<td>20.3</td>
<td>4.12</td>
<td>6.76</td>
<td>10.88</td>
</tr>
<tr>
<td>(I3) 80 mm CPE</td>
<td>32.7</td>
<td>6.66</td>
<td>33.8</td>
<td>89.4</td>
<td>221.5</td>
<td>20.1</td>
<td>3.66</td>
<td>5.95</td>
<td>9.60</td>
</tr>
<tr>
<td>CD (p=0.05)</td>
<td>1.09</td>
<td>0.23</td>
<td>0.61</td>
<td>2.19</td>
<td>6.24</td>
<td>1.14</td>
<td>0.33</td>
<td>0.36</td>
<td>0.62</td>
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<tr>
<td><strong>Weed management practices</strong></td>
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<tr>
<td>(W1) Weedy check</td>
<td>80.1</td>
<td>13.67</td>
<td>33.2</td>
<td>79.0</td>
<td>207.4</td>
<td>18.0</td>
<td>3.13</td>
<td>4.91</td>
<td>8.05</td>
</tr>
<tr>
<td>(W2) Weed free</td>
<td>0.00</td>
<td>0.00</td>
<td>35.3</td>
<td>97.4</td>
<td>234.3</td>
<td>22.5</td>
<td>4.97</td>
<td>8.34</td>
<td>13.30</td>
</tr>
<tr>
<td>(HW at 20 and 40 DAS)</td>
<td>(W3) Sulfosulfuron</td>
<td>28.0</td>
<td>6.66</td>
<td>34.2</td>
<td>93.7</td>
<td>229.5</td>
<td>21.6</td>
<td>4.72</td>
<td>7.85</td>
</tr>
<tr>
<td>(W4) Metribuzin</td>
<td>30.7</td>
<td>7.38</td>
<td>33.9</td>
<td>90.8</td>
<td>223.0</td>
<td>19.7</td>
<td>4.08</td>
<td>6.67</td>
<td>10.76</td>
</tr>
<tr>
<td>(W5) Metsulfuron-methyl</td>
<td>29.7</td>
<td>6.90</td>
<td>34.2</td>
<td>92.7</td>
<td>229.6</td>
<td>21.4</td>
<td>4.50</td>
<td>7.40</td>
<td>11.90</td>
</tr>
</tbody>
</table>
| 6 g/ha (post-em)                | CD (p=0.05)      | 0.13                   | 0.21                   | 0.31                          | 0.98                                | 3.28                          | 0.24              | 0.20              | 0.20                  | 0.35

(2007) and Rahim et al. (2010). Herbicidal treatments had favourable effect on the crop growth and yield compared to weedy check. Among weed management practices, application of sulfosulfuron significantly increased plant height, tiller/running meter, leafs/running meter, crop dry weight, grain, straw and biological yield over metribuzin and it were at par with metsulfuron-methyl. Maximum growth parameters and yield were recorded in weed free plots (HW at 20 and 40 DAS), because no weeds were observed in weed free plots, which may have resulted in increased nutrient, water, space and light supply to the wheat crop due to absence of crop-weed competition. This in turn might have resulted in greater photosynthesis and hence better translocation of photosynthates besides larger sink and stronger reproductive phase. These findings are in close conformity with those of Bharat and Kachroo (2007) and Singh et al. (2013). However, weedy check recorded poor crop growth which might be due to higher weed competition that reduces the availability of soil moisture and nutrients to the crop plants resulted significantly lower grain, straw and biological yield of wheat and this was in conformity with Singh et al. (2013) and Chhokar et al. (2013).

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