Response of summer groundnut (*Arachis hypogaea*) to irrigation regimes and mulching

B.S. RASKAR and P.G. BHOI

Water Management Project, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra 413 722

Received: December 2002

ABSTRACT

A field experiment was conducted during summer seasons of 1999-2001 at Rahuri, Maharashtra, to find out appropriate irrigation schedule for summer groundnut (*Arachis hypogaea* L.) and to evaluate the effect of mulch on crop performance in broad bed-furrow method. Twenty-four treatment combinations, comprising 4 irrigation regimes based on cumulative pan evaporation (CPE), viz. 75, 100, 125 and 150 mm CPE, and 6 mulching treatment, viz. sugarcane trash @ 5 tonnes/ha and plastic film mulch (7 micron) with and without kaoline 8% and the control. Among all the irrigation regimes, irrigation scheduled at 75 mm CPE to summer groundnut recorded significantly higher yield parameters, dry pod yield (34.08 q/ha) and net returns (Rs 32,012/ha) in broad bed furrow (60-30 cm x 6.67 cm) than 100, 125 and 150 mm CPE. Mulching of plastic film with kaoline spray (8%) was found effective and registered highest pod yield (34.70 q/ha) over rest of treatments. The net returns obtained owing to mulching with plastic film and sugarcane trash with and without kaoline spray were almost identical. The benefit : cost ratio indicated that the use of sugarcane trash @ 5 tonnes/ha was found economically feasible agronomic practice for summer groundnut. The total consumptive use of water (738 mm) was higher with minimum water-use efficiency (4.61 kg/ha-mm) when irrigation was scheduled at 75 mm CPE. The water-use efficiency was higher with use of plastic film mulch with kaoline spray (6.69 kg/ha-mm) and was lowest with the control (3.49 kg/ha-mm). On an average, the evapotranspiration losses were reduced to the extent of 25.77, 14.63 and 4.56% due to application of plastic film, sugarcane trash and kaoline spray, respectively.

Key words: Summer groundnut, Irrigation regimes, Mulching, Yield and Economics

In Maharashtra, groundnut (*Arachis hypogaea* L.) occupies dominant position as an oilseed crop and the crop is increasingly grown under irrigation during summer season in command areas as a cash crop. Area under groundnut cultivation in the state is about 0.52 million hectare with production of 0.55 million tonnes and productivity of 1,049 kg/ha. Out of this about 20% area comes under summer cultivation. It has great potential to increase the yield under summer season. This crop is more sensitive to water fluctuation and more or less at critical growth stages, which adversely influences the yield. Therefore, there is a need of efficient and economic use of irrigation water, so as to increase the area and productivity of summer groundnut. Borole (1986) recorded maximum yield of summer groundnut when irrigation was scheduled at 75 mm CPE. The broad bed furrows (BBF) techniques provides loose soil mass for developments of pods, besides, the furrows were beneficial for irrigation and drainage of excess water, Bhoi et al. (1984) and Nalwade and More (1993) reported significant response of BBF resulting in higher pod yield, therefore this technique was used. In recent year's use of plastic film, straws and antitranspirant have been used for minimizing water losses through evapotranspiration. The present experiment was therefore carried out, to find out appropriate irrigation schedule to increase the productivity of summer groundnut and to evaluate the effect of mulch on crop performance in broad bed furrows.

MATERIALS AND METHODS

A field experiment was conducted during 1999-01 during summer at Rahuri. The soil was clay loam, with organic carbon 0.45% available N 350 kg/ha, available P 18.7 kg/ha and available K 375 kg/ha, with pH 8.5. The soil-moisture content at 1/3 bar and 15 bar was 38.7 and 20.5% respectively. The bulk density was 1.28 g/cm³. Twentyfour treatment combinations, comprising 4 irrigation regimes based on cumulative pan evaporation (CPE),
mulching regimes from 75 to 150 mm CPE (Table 1). The moisture stress prevailed due to higher CPE values, adversely affected the yield parameters. An application of irrigation at 75 mm CPE resulted significantly higher dry pod yield of groundnut (34.08 q/ha) than the rest of irrigation treatment on broad bed furrow. The yield decreased significantly with increasing levels of CPE and was lowest at 150 mm CPE (26.99 q/ha). The favourable soil-moisture conditions created in the rhizosphere at 75 mm CPE benefiting in giving higher pod yield Mahakulkar et al. (1990) and Parihar et al. (1999) also reported similar trend. The differences in yield and yield parameters were significant due to mulching with antitranspirant. The use of 7 micron plastic film with koline (8%) spray gave significantly higher pod yield of summer groundnut (34.69 q/ha) over rest of mulching treatments on pooled mean basis. Similar trend was noticed in yield and yield parameters and quality aspects during each season also.

However, the use of sugarcane trash @ 5 tonnes/ha resulted 17.08% higher dry pod yield than the control (26.5 q/ha). Plastic film and sugarcane trash might have enhanced microbial activities due to favourable soil moisture and soil-temperature condition in rhizosphere of groundnut, resulting in quick release of nutrients and their uptake, which ultimately increased the pod yield of groundnut (Shyam Sunder, 1999). The use of kaoline spary 8% alone gave only 3.83% higher dry pod over the control (26.05 q/ha) and it was not found much effective in reducing ET losses. Shinde and Lomate (1979) also reported that, application of kaoline (3%) to summer groundnut did not influence the yield significantly. The oil (%) increased significantly under mulching than the control.

Table 1. Effect of irrigation regimes and mulching on yield and yield parameters of summer groundnut (pooled of 3 seasons)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Pods plant</th>
<th>Drypod weight/ plant (g)</th>
<th>100 pod weight (g)</th>
<th>100-kernel weight (g)</th>
<th>Dry pod yield (q/ha)</th>
<th>Shelling (%)</th>
<th>Oil (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1999</td>
<td>2000</td>
<td>2001</td>
<td>pooled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Irrigation regimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75 mm CPE</td>
<td>25.65</td>
<td>24.45</td>
<td>99.73</td>
<td>55.82</td>
<td>34.29</td>
<td>34.96</td>
<td>33.00</td>
</tr>
<tr>
<td>100 mm CPE</td>
<td>22.94</td>
<td>21.08</td>
<td>96.36</td>
<td>51.77</td>
<td>32.96</td>
<td>33.08</td>
<td>30.46</td>
</tr>
<tr>
<td>125 mm CPE</td>
<td>20.07</td>
<td>17.59</td>
<td>94.02</td>
<td>49.47</td>
<td>30.09</td>
<td>30.54</td>
<td>27.56</td>
</tr>
<tr>
<td>150 mm CPE</td>
<td>16.43</td>
<td>14.63</td>
<td>90.99</td>
<td>47.60</td>
<td>27.92</td>
<td>27.90</td>
<td>25.15</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>2.39</td>
<td>2.00</td>
<td>2.56</td>
<td>0.90</td>
<td>0.80</td>
<td>1.34</td>
<td>1.96</td>
</tr>
<tr>
<td>Mulching regimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cane trash @ 5 tonnes/ha</td>
<td>20.94</td>
<td>19.30</td>
<td>94.52</td>
<td>50.86</td>
<td>31.80</td>
<td>31.35</td>
<td>29.56</td>
</tr>
<tr>
<td>Plastic film (7 micron)</td>
<td>22.71</td>
<td>20.45</td>
<td>97.11</td>
<td>51.89</td>
<td>34.38</td>
<td>33.24</td>
<td>31.91</td>
</tr>
<tr>
<td>Kaoline 8%</td>
<td>19.63</td>
<td>18.26</td>
<td>93.59</td>
<td>50.22</td>
<td>27.21</td>
<td>28.67</td>
<td>25.41</td>
</tr>
<tr>
<td>Sugarcane trash @ 5 tonnes/ha + Kaoline 8%</td>
<td>21.85</td>
<td>19.86</td>
<td>95.78</td>
<td>51.34</td>
<td>32.78</td>
<td>32.80</td>
<td>30.68</td>
</tr>
<tr>
<td>Plastic film + kaoline 8%</td>
<td>24.29</td>
<td>21.32</td>
<td>98.31</td>
<td>52.35</td>
<td>35.58</td>
<td>35.30</td>
<td>33.21</td>
</tr>
<tr>
<td>Control (No mulch)</td>
<td>18.21</td>
<td>17.48</td>
<td>92.35</td>
<td>49.59</td>
<td>26.33</td>
<td>27.36</td>
<td>24.48</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td>1.19</td>
<td>0.91</td>
<td>3.70</td>
<td>NS</td>
<td>1.12</td>
<td>1.69</td>
<td>1.25</td>
</tr>
</tbody>
</table>
Table 2. Water requirement and economics of summer groundnut as influenced by different treatments (Average of 3 seasons)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Profile depletion (mm)</th>
<th>Effective irrigation depth (mm)</th>
<th>Consumptive use (mm)</th>
<th>Total water use (mm)</th>
<th>WUE (kg/ha)</th>
<th>Net returns (Rs/ha)</th>
<th>Benefit: cost ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation regimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>75 mm CPE</td>
<td>618</td>
<td>69</td>
<td>618</td>
<td>636</td>
<td>687</td>
<td>4.79</td>
<td>30,185</td>
</tr>
<tr>
<td>100 mm CPE</td>
<td>618</td>
<td>69</td>
<td>618</td>
<td>636</td>
<td>687</td>
<td>4.79</td>
<td>30,185</td>
</tr>
<tr>
<td>125 mm CPE</td>
<td>618</td>
<td>69</td>
<td>618</td>
<td>636</td>
<td>687</td>
<td>4.79</td>
<td>30,185</td>
</tr>
<tr>
<td>150 mm CPE</td>
<td>618</td>
<td>69</td>
<td>618</td>
<td>636</td>
<td>687</td>
<td>4.79</td>
<td>30,185</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mulching regimes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cane trash @ 5 tonnes/ha</td>
<td>567</td>
<td>69</td>
<td>618</td>
<td>636</td>
<td>687</td>
<td>4.79</td>
<td>30,185</td>
</tr>
<tr>
<td>Plastic film (7 micron)</td>
<td>484</td>
<td>69</td>
<td>618</td>
<td>553</td>
<td>687</td>
<td>5.96</td>
<td>30,599</td>
</tr>
<tr>
<td>Kaoline 8%</td>
<td>643</td>
<td>69</td>
<td>618</td>
<td>712</td>
<td>687</td>
<td>3.81</td>
<td>22,366</td>
</tr>
<tr>
<td>Cane trash @ 5 tonnes/ha + kaoline 8%</td>
<td>540</td>
<td>69</td>
<td>618</td>
<td>609</td>
<td>687</td>
<td>5.27</td>
<td>30,003</td>
</tr>
<tr>
<td>Plastic film + kaoline 8%</td>
<td>450</td>
<td>69</td>
<td>618</td>
<td>519</td>
<td>687</td>
<td>6.69</td>
<td>30,466</td>
</tr>
<tr>
<td>Control (no mulch)</td>
<td>677</td>
<td>69</td>
<td>618</td>
<td>746</td>
<td>687</td>
<td>3.49</td>
<td>22,961</td>
</tr>
<tr>
<td>CD (P=0.05)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Economic returns

Irrigation scheduled at 75 mm CPE to summer groundnut recorded significantly higher net returns (Rs 32,012/ha) and benefit: cost ratio (2.60) than rest of irrigation treatments. Net returns were significantly reduced with each increased level of CPE. Similarly, the net returns were significantly higher dry the use of plastic film mulch with kaoline spray over use of kaoline spary alone and the control. However, the net returns obtained due to mulching with plastic film and sugarcane trash with and without kaoline spray were almost equally identical indicating that, the use of sugarcane trash @ 5 tonnes/ha for summer groundnut was economical beneficial internrs on net returns and benefit: cost ratio (2.73). Shinde and Firake (1998) also reported that use of sugarcane trash significantly increased the benefit: cost ratio and net returns in summer chilli compared with plastic film. Use of kaoline spray (8 %) resulted in the minimum net returns and hence it was not beneficial in summer groundnut.

Irrigation studies

Irrigation regimes had a marked influence on water use and water-use efficiency. The average irrigation required that to summer groundnut was 618 mm. The profile depletion of water, total water requirement and consumptive use was maximum when irrigation was scheduled at 75 mm CPE, with minimum water-use efficiency (4.61 kg/ha/mm). The mean consumptive use at 75 mm CPE (738 mm) was 36.66 % higher than 150 mm CPE (540 mm).

This indicates that delayed irrigation were not congeial for obtaining high WUE in summer groundnut. The profile depletion and consumptive use was lowest in the treatments of plastic film in combination with kaoline spray as compared to the rest treatments but it was highest in control treatments. The water use-efficiency was 3.49 - 6.69 kg/ha/mm and it was higher in use of plastic film mulch with kaoline (6.69 kg/ha/mm) and was lowest with the control (3.49 kg/ha-mm). These indicate that the water was most efficiently utilized under the plastic film mulch. On an average, the ET losses were reduced to the extent of 25.77, 14.63 and 4.56 % due to application of plastic film, sugarcane trash and kaoline spray, respectively.

Thus growing of summer groundnut on broad-bed furrow with irrigation scheduled at 75 mm CPE using plastic film was beneficial for achieving higher productivity and reducing the ET losses. Use of sugarcane trash @ 5 tonnes/ha, as mulch was equally beneficial in terms of net returns and benefit: cost ratio as that of plastic film mulch.

REFERENCES


