Growth and yield attributes of summer pearlmillet (*Pennisetum glaucum* L.) as influenced by irrigation, mulches and antitranspirant

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Accepted : October, 2009

**SUMMARY**

An experiment was conducted during the summer season of the year 2007 and 2008 to study the “Effect of irrigation, mulches and antitranspirant on growths and yield of summer pearlmillet (*Pennisetum glaucum* L.) under south Saurastra conditions”. Among different irrigation scheduling treatments, treatment I₂ (1.0 IW : CPE ratio), being at par with treatment I₁ (0.8 IW : CPE ratio), recorded significantly higher values for yield attributes viz., plant height, number of effective tillers plant⁻¹, leaf area index, length and girth of earhead, grain weight plant⁻¹, test weight and grain yield. While, significantly the lowest values of these attributes were observed under treatment I₃ (0.6 IW : CPE ratio). Treatment M₁ (groundnut shell mulch) recorded significantly higher values for growth and yield attributes and grain yield over treatment M₀ (control). However, treatment M₃ was remained at par with treatment M₂ (wheat cut straw mulch). Application of 6 % kaolin spray (AT₃) recorded significantly the highest values for growth and yield attributes and grain yield as compared to control treatment (AT₀) except number of effective and non effective tillers plant⁻¹ and harvest index.

**Key words :** Irrigations, Mulches, Antranspirant, Pearl millet

Agricultural system being basically a photosynthetic one, availability of water is the major motive factor and hence it must be assessed for its efficiency in terms of both primary productivity and useful end products. Moreover, water plays a vital role in the metabolic processes of the plant and therefore, it has a great impact on growth, development and productivity. Thus, water is considered as an elixir of plant life.

Summer cultivation of pearlmillet particularly in the irrigated areas of Gujarat State has got importance because of the assurance of targeted crop yield. Irrigation in summer pearlmillet is one of the major inputs of crop production. The research work on various agronomic aspects have been undertaken for pearlmillet crop. But, the information regarding water requirement and irrigation scheduling as well as the use of mulches and antitranspirant for summer pearmlillet crop is lacking for the medium black soils of south Saurastra agroclimatic zone. Therefore, the present experiment was conducted during the summer seasons of the years 2007 to 2008 to study the “Effect of irrigation, mulches and antitranspirant on growth and yield of summer pearlmillet (*Pennisetum glaucum* L.) under south Saurastra conditions”.

**MATERIALS AND METHODS**

A field experiment was conducted during summer seasons of 2007 and 2008 at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh. The texture of the experimental soil was silty clay with bulk density 1.33 mg/m, field capacity 47 %, wilting point 20 %, pH 7.7, electrical conductivity 0.56 dS m⁻¹ and organic carbon content 0.69 %. The experiment was laid out in split-split plot design with four replications. Treatments comprised of 3 irrigation levels[0.6 IW : CPE ratio (I₁), 0.8 IW : CPE ratio (I₂), 1.0 IW : CPE ratio (I₃)] in main plots, 3 mulching levels [control (M₀), wheat cut straw @ 5 t ha⁻¹ (M₁) and groundnut shell @ 5 t ha⁻¹ (M₂)] and 2 antitranspirant levels [control( AT₀) and : 6 % Kaolin spray at 20 and 50 DAS (AT₃)] in sub-sub plots. Pearl millet variety GHB-558 was sown by drilling on February 9, during both the years 2006 and 2007 at row spacing of 45 cm with seed rate of 3.5 kg ha⁻¹. Crop was fertilized with 60-60-0 NPK kg ha⁻¹ as basal before sowing and 60 kg N ha⁻¹ was applied in two equal splits at an interval of 35-40 days after sowing during both the seasons of experimentation.

The irrigation treatments were imposed after a common irrigation of 50 mm depth. The mulches were applied at 35 days after sowing of the crop in the respective treatments, leaving the pearlmillet rows open. Water spray as a control treatment (AT₀) and 6 % kaolin (AT₃) were sprayed on the crop plants at 20 and 50 days after sowing of the crop during both the years. The kaolin @ 600 l ha⁻¹ solution was applied with a hand operated knapsack...
sprayer fitted with a fan type nozzle in the morning time under dry and clear sun condition. The data were recorded for seed and straw yield on net plot basis and then converted on hectare basis.

RESULTS AND DISCUSSION

The results obtained from the present investigation are presented below:

Effect on growth:

Growth parameters like periodical plant height and LAI (Table 1) were significantly influenced due to different levels of irrigation, mulches and application of antitranspirant consistently throughout the crop life span. Plant height was increased considerably by irrigating the crop at 1.0 IW:CPE ratio over 0.6 IW:CPE ratio at 30, 45, 60 DAS and at harvest, and the increment was to the tune of 7.4, 11.9, 11.3 and 4.8 per cent, respectively. Leaf area index recorded at 30, 60 DAS and at harvest were increased with increase in irrigation levels from 0.6 to 1.0 IW:CPE ratio. Such a positive response might be due to increase in number of irrigations, which raised the moisture status of the soils and availability of soil moisture to the crop plant. Thus plant can absorb more nutrients from the soil which encourage physiological processes such as cell division and expansion. Hence, the number of tillers per plant and size of leaves were increased and ultimately it reflected in higher plant height and LAI. These findings are in agreement with Vyas et al. (1994).

Significantly maximum plant height noted under M₂ (groundnut mulch) over M₁ (no mulch) but it was at par with M₃ (wheat cut straw mulch) at 30, 45, 60 DAS and at harvest (Table 1). The increase in plant height was attributed to sufficient soil moisture near root zone due to minimized the evaporation loss, resulted in extended period of storage and availability of moisture also leading to higher uptake of nutrient for proper growth and development of plants, resulted higher plant height as compared to control treatment. Similar findings were also reported by Kaushik and Lal (1996) and Chaudhary et al. (2002). The leaf area index (LAI) recorded at 30 and 60 DAS and at harvest were increased with the application of groundnut shell mulch (M₃) or wheat cut straw mulch (M₃) as compared to control (M₁). The highest LAI under groundnut shell mulch and wheat cut straw mulch due to congenial soil moisture for better growth of leaves during entire life span, the reduction in evaporation losses of soil moisture caused by mulches covered the soil surface in between two rows of pearl millet. This result is in agreement with that of Jat and Gautam (2000).

The maximum values of plant height at 30, 45 and 60 DAS and at harvest and leaf area index (LAI) at 30 and 60 DAS and at harvest were recorded under 6% Kaolin spray at 20 and 50 DAS (AT₁). Improvement in these growth parameters with Kaolin spray might be due to application of Kaolin keep transpiration check to reasonable extent owing to reflection of incident radiation from the leaf surface or to partial closing of stomata. Thus, the better strata of the plants due to this treatment might be resulted in less leaf senescence and higher photosynthates ultimately resulting in to higher plant height and leaf area index due to Kaolin spray. Kaolin acted as transpiration suppressants, reducing heat load on the leaf and also reduced stomatal conductance. The results are in accordance with De et al. (1983b).

Effect on yield attributes:

Various yield attributes viz., number of effective and non effective tillers plant⁻¹, length and girth of earhead, grain weight plant⁻¹ and test weight (Table 2) recorded under irrigation levels 1.0 and 0.8 IW:CPE ratio did not differ significantly but remarkably higher over 0.6 IW:CPE ratio treatment. This might be attributed to the increase in levels of irrigation promotes the vegetative growth, accelerates flowering and thus increase number of effective tillers plant⁻¹. The moisture stress in soil might be less as compared to lower IW:CPE ratio, ultimately resulting in to less number of non effective tillers plant⁻¹. Due to sufficient moisture surrounding root zone promotes vegetative growth and hence length and girth of earhead increased under higher number of irrigation. The test weight was increased with increase in irrigation levels. Water is also essential component and acts as a career of food for the crop plants. Thus, water accelerates the process of photosynthesis, ultimately resulting into accumulation of more photosynthates which might help in increasing the size and weight of the grains resulting higher test weight of grains. These results collaborate the findings of Vyas et al. (1994).

Among the yield attributes studied, number of effective tillers plant⁻¹, length and girth of earhead, grain weight plant⁻¹ and test weight increased significantly under groundnut shell mulch (M₃) and wheat cut straw mulch (M₃) over no mulch (control). Such a positive response might be due to water losses caused by evaporation reduced by using both mulches resulting more availability of soil moisture resulted in cell turgidity and eventually higher meristematic activity leading to more foliage development, greater photosynthetic rate and consequently better plant growth, manifested in terms of effective tiller plant⁻¹, increased length and girth of earhead
and reflected in higher grain weight plant\(^{-1}\) and test weight. This is in confirmative with the findings of Kaushik and Lal (1996) and Chaudhary et al. (2002).

Significantly higher number of effective tillers plant\(^{-1}\), earhead length and girth of earhead, grain weight plant\(^{-1}\) and test weight recorded under 6% Kaolin spray at 20 and 50 DAS over control (water spray) in pooled results. The increase in yield attributes would be attributed to maintenance of favourable soil moisture status in the root zone because application of Kaolin keep transpiration in check to a reasonable extent owing to reflection of incident radiation from the leaf surface or to partial closing of stomata, which in turn helped plants to maintain better turgor, thus, utilized moisture as well as nutrients more efficiently from the moist soil and enhanced vegetative growth. Optimum leaf area made possible for the high rate of photosynthetic activity during the reproductive phase and the channelisation of the photosynthates accumulated during the vegetative phase to the sink. The accelerated rates helped eventual increase in number of effective tillers plant\(^{-1}\), length of earhead, girth of earhead, grain weight plant\(^{-1}\) and test weight. These finding are in


### Table 2: Effect of irrigation schedule, mulches and anti-transpirant on yield and yield attributes of pearl millet (pooled two years)

<table>
<thead>
<tr>
<th>Treatments</th>
<th>Number of tillers plant(^{-1})</th>
<th>Length of earhead (cm)</th>
<th>Girth of earhead (cm)</th>
<th>Grain weight plant(^{-1}) (g)</th>
<th>1000 grains weight (g)</th>
<th>Yield (kg ha(^{-1}))</th>
<th>Harvest index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation levels (I)</td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>0.6 IW : CPE ratio (I(_1))</td>
<td>3.89</td>
<td>2.29</td>
<td>18.36</td>
<td>9.17</td>
<td>44.8</td>
<td>9.88</td>
<td>7329</td>
</tr>
<tr>
<td>0.8IW : CPE ratio (I(_2))</td>
<td>4.20</td>
<td>1.96</td>
<td>20.76</td>
<td>9.60</td>
<td>50.01</td>
<td>10.77</td>
<td>7858</td>
</tr>
<tr>
<td>1.0 IW : CPE ratio (I(_3))</td>
<td>4.32</td>
<td>1.81</td>
<td>21.44</td>
<td>10.02</td>
<td>53.40</td>
<td>10.87</td>
<td>8212</td>
</tr>
<tr>
<td>C.D. (P=0.05)</td>
<td>0.14</td>
<td>0.19</td>
<td>2.25</td>
<td>0.28</td>
<td>2.99</td>
<td>0.38</td>
<td>391</td>
</tr>
<tr>
<td>Mulches (M)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control (M(_1))</td>
<td>3.98</td>
<td>2.04</td>
<td>19.22</td>
<td>9.28</td>
<td>43.28</td>
<td>10.30</td>
<td>7371</td>
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<tr>
<td>Wheat cut straw @ 5 t ha(^{-1}) (M(_2))</td>
<td>4.19</td>
<td>2.08</td>
<td>20.29</td>
<td>9.69</td>
<td>51.08</td>
<td>10.53</td>
<td>7881</td>
</tr>
<tr>
<td>Groundnut shell @ 5 t ha(^{-1}) (M(_3))</td>
<td>4.24</td>
<td>1.94</td>
<td>21.05</td>
<td>9.83</td>
<td>52.47</td>
<td>10.69</td>
<td>8148</td>
</tr>
<tr>
<td>C.D. (P=0.05)</td>
<td>0.14</td>
<td>NS</td>
<td>0.66</td>
<td>0.26</td>
<td>3.21</td>
<td>0.19</td>
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<td>Antitranspirant (AT)</td>
<td></td>
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<tr>
<td>Control (Water spray) (AT(_0))</td>
<td>4.03</td>
<td>2.06</td>
<td>19.78</td>
<td>9.36</td>
<td>47.06</td>
<td>10.40</td>
<td>7596</td>
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<tr>
<td>6 % Kaolin spray at 20 and 50 DAS (AT(_1))</td>
<td>4.25</td>
<td>1.98</td>
<td>20.59</td>
<td>9.83</td>
<td>50.82</td>
<td>10.61</td>
<td>8004</td>
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<tr>
<td>C.D. (P=0.05)</td>
<td>NS</td>
<td>NS</td>
<td>0.41</td>
<td>0.18</td>
<td>2.33</td>
<td>0.20</td>
<td>254</td>
</tr>
</tbody>
</table>

N.S.- Non significant
according to Kaushik and Lal (1996).

Effect on yield:

It is evident from the data presented in Table 2 that the levels of irrigation reflected significant effect on grain and dry fodder yield. Treatment I₁ (1.0 IW:CPE ratio) and I₂ (0.8 Iw:CPE ratio) did not produce any considerably difference in grain and dry fodder yield of summer pearl millet. However, both these irrigation levels produced appreciably higher grain and dry fodder yield of summer pearl millet to the extent of 19.27 and 13.73 per cent in grain and 12.05 and 7.22 per cent in dry fodder yield over I₁ (0.6 IW:CPE ratio), respectively in pooled result. Increase in irrigation frequency tended in increase consumptive use of water, which provided congenial condition throughout the growth period of the crop more over less moisture stress experienced by crop during their vegetative and reproductive growth period, that too later stages of crop growth resulting in an improvement of growth and yield attributing characters, thereby produced higher grain and dry fodder yield. These results are in line with those reported by Vyas et al. (1994).

Groundnut shell mulch and wheat cut straw mulch recorded significantly higher grain and dry fodder yield than control (no mulch) treatment. The degree of increased in grain and dry fodder yield under groundnut shell mulch was to the tune of 13.17 and 10.19 per cent over control (no mulch) treatment, respectively. While under wheat cut straw mulch was to the extent of 8.84 and 6.69 per cent higher over control. The highest grain and dry fodder yield recorded under mulch because mulch play an important role in changing hydro-thermal regime of soil and conserving soil moisture. Hence, congenial soil moisture for favourable growth condition available during major life period of pearl millet crop and consequently the higher growth and yield attributing characters reflected higher grain and fodder yield of summer pearl millet. These findings are in conformity with those obtained by Chaudhary et al. (2002).

An application of 6 % Kaolin spray at 20 and 50 DAS recorded significantly higher grain yield (4922 kg ha⁻¹ and dry fodder yield (8004 kg ha⁻¹) over control (water spray) in pooled results. The magnitude of increase in grain was 11.38 per cent during the year 2007, 9.03 per cent in the year 2008 and 10.21 per cent in combined analysis. Similarly, application of 6 % Kaolin spray at 20 and 50 DAS recorded higher dry fodder yield during both the years and in pooled results. The magnitude of increase in fodder yield was 5.51, 5.24 and 5.37 per cent during the year 2007, 2008 and in pooled results, respectively over control. Higher grain yield and fodder yield accrued under Kaolin spray treatment would be attributed to favourable effect of higher relative water control in plant because approximately 99 per cent of the water absorbed by plants is lost in transpiration but application of Kaolin might keep transpiration in check to a reasonable extent owing to reflection of incident radiation from the leaf surface or to partial closing of stomata. Thus, better moisture status of the plant due to Kaolin spray resulted in less leaf senescence and higher photosynthesis. These favourable effects could resulted in better grain development and ultimately in increased grain yield. This higher yield of grain and fodder might also be due to increase growth and yield attributing characters. It was further noticed that Kaolin spray without any reduction in total water depletion compared to control, resulted in higher fodder and grain yield. Such, appreciable increased in pearl millet grain and fodder yield due to spraying of Kaolin have been also reported by Kaushik and Gautam (1994).

REFERENCES


