EFFECT OF EARTHING UP AND FERTILIZER LEVELS ON GROWTH AND YIELD OF SPRING PLANTED SUGARCANE (*SACCHARUM OFFICINARUM* L.)*

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ABSTRACT

A study was undertaken at Sugarcane Research Institute, AARI, Faisalabad, Pakistan during February 2006 and 2007. Three earthing up treatments i.e. no earthing up, earthing up 90 days after planting (DAP) and earthing up at 120 DAP and five fertilizer levels i.e. F1 (no fertilizer), F2 (100-100-100 kg NPK/ha), F3 (150-100-100 kg NPK/ha), F4 (200-150-150 kg NPK/ha) and F5 (250-150-150 kg NPK/ha) were tried on sugarcane cultivar HSF-240 in RCBD with four replications in plots measuring 3.6 x 6.5 m. Crop was sown in 150 cm apart trenches using 75000 double budded setts per hectare. Maximum number of tillers (14.34/m²) were obtained with no earthing up followed by earthing up at 120 DAP (14.28 tillers/m²). Maximum millable canes (113974/ha), stripped cane weight (0.89 kg/cane) and cane yield (100.96 t/ha) were noted in earthing up at 120 DAP. As regards fertilizer levels, higher number of tillers (16.02/m²) was produced by F5 (250-150-150 kg NPK/ha) followed by F4 (200-150-150 kg NPK/ha) (15.29 tillers/m²). Maximum striped cane weight (0.96 kg/cane) was produced by F3 (150-100-100 kg NPK/ha). As far as interaction is concerned earthing up at 120 DAP with F5 (250-150-150 kg NPK/ha) excelled in stripped cane yield (122.85 t/ha) which was at par (120.20 t) with earthing up at 120 DAP and F4 (200-150-150 kg NPK/ha).

KEYWORDS: *Saccharum officinarum*; NPK fertilizers; agronomic characters; Pakistan.

INTRODUCTION

Sugarcane (*Saccharum officinarum* L.) is a plant of warm temperature of tropical regions. It is being grown successfully in sub-tropics also. It is one of the major cash crops of Pakistan which contributes to value added agriculture and GDP @ 3.6 and 0.8 percent, respectively. It provides raw material to 78 sugar mills of the country and provides employment to over four million people of Pakistan (27). Pakistan ranks 5th in cane area and production but 11th in average cane yield per hectare. The average cane yield of Pakistan is 48.9 tons per hectare which is

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lower than the world average (66.06 t/ha) and advanced cane growing countries like Australia (65.56 t), Brazil (85.00 t) and China (72.84 t) during 2004-05 (11). Among many factors responsible for this low yield, malnutrition and lodging of crop adversely affect the cane yield (12). Earthing up is very important to check lodging and get the erect crop as the lodged crop is very difficult to harvest (31). The earthing up to a height of 30 cm leads to 12 percent increase in millable cane yield over no earthing up. The ridging operation not only buries weeds present in the field but also provides protection against the fast winds (18). About 30 percent reduction in cane yield due to lodging has been reported by Ahmad (3). In a field study under Faisalabad conditions, earthing up gave significantly more cane yield than no earthing up (9). The time of ridging is very important which should not exceed 10-12 weeks other-wise mechanical injuries to roots may adversely affect the cane yield (10). Chattha et al. (16) reported that lodging reduces cane yield. Aslam et al. (13) observed significant cane yield improvement due to earthing up. Ahmad et al. (4) reported that increasing doses of nitrogen increased the number of tillers per plant. Mali et al. (23) found that all nitrogen levels produced more tillers over the control and significantly higher tillers were recorded at 300 kg N per hectare. Clement (19) also observed that phosphorus deficiency is associated with lack of tillering. Rathore et al. (28) found that 100 kg K₂O per hectare applied as basal fertilizer resulted in a significantly higher number of tillers as compared with other treatments. Mathur (26) reported that maximum number of millable canes was obtained with the application of 225 kg N, 150 kg P and 150 kg K₂O per hectare. Sandhu (30) reported that NPK @ 100-100-100 kg per hectare produced higher number of millable canes. Malik (24) stated that maximum number of millable canes per unit area was obtained from 170-110-0 kg NPK per hectare. Akhtar et al. (5) reported that maximum number of millable canes was produced at 200-100-100 kg NPK per hectare, while Ali et al. (7) recorded maximum number of millable canes at 250-112-112 kg NPK. According to Ricaud and Arcenaux (29) stripped cane yield was increased with the increase of nitrogen alone as well as by increase of all three NPK fertilizer combinations over control. Ayub et al. (14) observed that NPK application @ 200-150-150 kg per hectare was optimum level for maximum cane yield. In another study (5) significantly higher cane yield (115 t/ha) was recorded in NPK dose of 250-100-100 kg during 1994-95 and 200-100-100 kg NPK during 1995-96 (118.7 t/ha). Ali and Afghan (6) observed that stripped cane yield was significantly increased (131.56 t/ha) with 200-150-150 kg NPK against 168-112-112 kg NPK per hectare (114.48 t/ha). Ali et al. (7) obtained maximum stripped-cane yield from 250-112-112 kg NPK per hectare. Chaudhry and Chattha (17) recorded maximum stripped-cane yield (71.12 t/ha) using 200-100-150 kg NPK per hectare.
In present research work effect of time of earthing up at different fertilizer doses on the yield of sugarcane was studied.

MATERIALS AND METHODS

This study was conducted at Sugarcane Research Institute, AARI, Faisalabad, Pakistan during 2006 and 2007 in RCBD with four replications. Three earthing up treatments, no earthing up (E1), earthing up 90 days after planting (DAP) (E2) and earthing up at 120 DAP (E3) and five fertilizer levels i.e. F1 (no fertilizer), F2 (100-100-100 kg NPK/ha), F3 (150-100-100 kg NPK/ha), F4 (200-150-150 kg NPK/ha) and F5 (250-150-150 kg NPK/ha) were tried. Sugarcane crop (cv. HSF-240) was planted during end February in both years in plots measuring 3.6 x 6.5 m in 150 cm apart trenches using seed rate of 75000 double budded setts per hectare. The crop was harvested on December, 2006 and 2007. The data on tillering per square meter was recorded at 90 DAP. The data on number of millable canes and cane yield were recorded from whole plot at harvest and then were calculated on per hectare basis. The data were analysed statistically using Fisher’s analysis of variance technique and least significant difference test (LSD) at 5 percent probability level was employed to compare differences among treatment means (33).

RESULTS AND DISCUSSION

Number of tillers/m²

The data (Table 1) revealed that earthing up and different fertilizer levels affected the average number of tillers per unit area significantly. The average number of tillers was significantly more (14.34/m²) in no earthing up than earthing up at 90 DAP (13.80/m²) but was at par with earthing up at 120 DAP (14.28/m²). It was due to the fact that earthing up checked tillering, therefore in case of no earthing up, more tillers were produced than early earthing up. Similar results were recorded by Shukla et al. (32) who reported that earthing up reduced the tiller population. In case of fertilizer levels, average number of tillers significantly increased with increased fertilizer doses. It was higher (16.02/m²) in F5 (250-150-150 kg NPK/ha) followed by F4 (200-150-150 kg NPK/ha) (15.29/m²). Similar results were reported earlier (1, 2, 25, 28).

As regards interaction, E₁F₅ (no earthing up with fertilizer dose of 250-150-150 kg NPK/ha) significantly excelled (16.34/m²) the all interactions except E₃F₅

Table 1. Effect of earthing up and fertilizer levels on tillers/m².
Earthing up | Fertilizer treatments (kg NPK/ha) | E₁ (no earthing up) | E₂ (90 DAP) | E₃ (120 DAP) | Mean
--- | --- | --- | --- | --- | ---
F₁ = 0-0-0 (Control) | 12.31f | 11.59g | 12.50f | 12.13e |
F₂ = 100-100-100 | 13.25e | 13.00e | 13.06e | 13.10d |
F₃ = 150-100-100 | 14.19d | 14.09d | 14.16d | 14.15c |
F₄ = 200-150-150 | 15.59b | 14.84c | 15.44b | 15.29b |
F₅ = 250-150-150 | 16.34a | 15.47b | 16.25a | 16.02a |
Mean | 14.34a | 13.80b | 14.28a -

LSD: Earthing up (E) = 0.194; Fertilizer treatments (F) = 0.251; ExF = 0.434
Means having different letters differ significantly from each other by LSD at P = 0.05.

(16.25 tillers/m²). The interaction E₁F₁ (no earthing up and no fertilizer) produced the lowest tillers (12.31/m²).

**Number of millable canes**

Average number of millable canes per hectare was significantly higher (113974/ha) in E₃ (120 DAP) than other earthing up treatments. Similarly earthing up at 90 DAP (E₂) produced significantly more number of millable canes (109632/ha) than no earthing up (Table 2). These results are in line with those of Shukla et al. (32). In case of fertilizer levels, F₄ (200-150-150 kg NPK) produced significantly higher millable canes (116487/ha) than F₁, F₂, F₅ and was at par with F₃ (150-100-100 kg NPK/ha) (115386/ha). These results do not agree to those of Deveraj and Shamugasundaram (20), who reported that 225 kg N per hectare improved millable canes over that of 175 kg N. However, Trevedi and Saini (34) obtained significantly more canes from 180 kg N than 60 kg N and control. Kamel (21) also reported maximum number of millable canes with maximum fertilizer levels.

**Table 2. Effect of earthing up and fertilizer levels on number of millable canes/ha.**

| Fertilizer treatments (kg NPK/ha) | E₁ (no earthing up) | E₂ (90 DAP) | E₃ (120 DAP) | Mean |
--- | --- | --- | --- | ---
F₁ = 0-0-0 (Control) | 96090cd | 98740bc | 100210cd | 98347c |
F₂ = 100-100-100 | 104460bc | 107480bc | 111130b | 107690b |
F₃ = 150-100-100 | 110390b | 117440ab | 118330a | 115386a |
F₄ = 200-150-150 | 110290b | 117990ab | 121180a | 116487a |
F₅ = 250-150-150 | 102750c | 106510bc | 119020a | 109427b |
Mean | 104796c | 109632b | 113974a -

LSD: Earthing up (E) = 2491; Fertilizer treatments (F) = 3216; ExF = 7050
Means having different letters differ significantly from each other by LSD at P = 0.05.

As regards interaction (Table 2), significantly higher average number of millable canes (121180/ha) were produced by E₃F₄ (earthing up at 120 DAP with 200-150-150 kg NPK/ha). E₃F₅, E₃F₃, E₂F₅ and E₂F₄ were at par with it.
Significantly, the lowest number of millabe canes was produced by interaction $E_1 F_1$ (96090/ha), $E_2 F_1$ (98740/ha) and $E_3 F_1$ (100210/kg).

**Stripped cane weight**

Stripped cane weight was significantly higher (0.89 kg/cane) in earthing up at 120 DAP than 90 DAP and no earthing up. Earthing up at 90 DAP also showed higher stripped cane weight (0.85 kg/cane) than no earthing up (0.81 kg/cane) (Table 3). As regards fertilizer levels, $F_3$ (150-100-100 kg NPK/ha) produced significantly higher stripped cane weight (0.96 kg/cane) than $F_2$ (0.76 kg) and $F_1$ (0.60 kg) and was at par with $F_4$ and $F_5$ (0.95 kg each) (Table 3). Significantly the lowest stripped cane weight (0.60 kg/cane) was shown in control conditions (no fertilizer). The data also showed that there was non-significant interactive effect of earthing up and fertilizer dose on stripped cane weight.

Table 3. Effect of earthing up and fertilizer levels on stripped cane weight (kg/cane).

<table>
<thead>
<tr>
<th>Fertilizer treatments (kg NPK/ha)</th>
<th>$E_1$ (no earthing up)</th>
<th>$E_2$ (90 DAP)</th>
<th>$E_3$ (120 DAP)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>$F_1$ = 0-0-0 (Control)</td>
<td>0.53</td>
<td>0.58</td>
<td>0.69</td>
<td>0.60c</td>
</tr>
<tr>
<td>$F_2$ = 100-100-100</td>
<td>0.72</td>
<td>0.78</td>
<td>0.80</td>
<td>0.76b</td>
</tr>
<tr>
<td>$F_3$ = 150-100-100</td>
<td>0.94</td>
<td>0.97</td>
<td>0.98</td>
<td>0.96a</td>
</tr>
<tr>
<td>$F_4$ = 200-150-150</td>
<td>0.91</td>
<td>0.97</td>
<td>0.98</td>
<td>0.95a</td>
</tr>
<tr>
<td>$F_5$ = 250-150-150</td>
<td>0.93</td>
<td>0.93</td>
<td>1.01</td>
<td>0.95a</td>
</tr>
<tr>
<td>Mean</td>
<td>0.81c</td>
<td>0.85b</td>
<td>0.89a</td>
<td></td>
</tr>
</tbody>
</table>

LSD: Earthing up ($E$) = 0.037; Fertilizer treatments ($F$) = 0.048; ExF = Non-significant
Means having different letters differ significantly from each other by LSD at P = 0.05.

**Stripped cane yield**

The data (Table 4) revealed that stripped cane yield was significantly higher (100.69 t/ha) in earthing up at 120 DAP than 90 DAP and no earthing up. Similarly, earthing up at 90 DAP produced significantly higher cane yield (95.70 t/ha) than no earthing up (84.29 t/ha). These results are in line with those of Aslam et al. (13) where earthing up with spade and ridger increased cane yield significantly by 19.20 and 18 percent, respectively over no earthing up. Similarly, Minhas et al. (26) reported that earthing up is effective for increase in cane yield with earthing up by tractor mounted cane ridger. With regards to fertilizer levels, significantly more average cane yield (113.65 t/ha) was produced by 250-150-150 kg NPK. These results agree to those of Ali and Afghan (6) where stripped cane yield was significantly increased with 200-150-150 kg NPK against 168-112-112 kg NPK per hectare. Ali et al. (7) also reported an increase in cane yield with maximum NPK dose (275-200-200 kg/ha). Similar results have also been reported earlier (15, 22).
Table 4. Effect of earthing up and fertilizer levels on stripped cane yield (t/ha).

<table>
<thead>
<tr>
<th>Fertilizer treatments (kg NPK/ha)</th>
<th>Earthing up</th>
<th>E1 (No earthing up)</th>
<th>E2 (90 DAP)</th>
<th>E3 (120 DAP)</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1 = 0-0-0 (Control)</td>
<td>47.29j</td>
<td>53.71i</td>
<td>58.81h</td>
<td>53.27</td>
<td></td>
</tr>
<tr>
<td>F2 = 100-100-100</td>
<td>75.16g</td>
<td>81.42f</td>
<td>87.07e</td>
<td>81.22</td>
<td></td>
</tr>
<tr>
<td>F3 = 150-100-100</td>
<td>102.90d</td>
<td>111.40c</td>
<td>115.86b</td>
<td>110.05</td>
<td></td>
</tr>
<tr>
<td>F4 = 200-150-150</td>
<td>92.20e</td>
<td>117.78b</td>
<td>120.20ab</td>
<td>110.06</td>
<td></td>
</tr>
<tr>
<td>F5 = 250-150-150</td>
<td>103.88d</td>
<td>114.21c</td>
<td>122.85a</td>
<td>113.65</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>84.29</td>
<td>95.70</td>
<td>100.96</td>
<td>93.56</td>
<td></td>
</tr>
</tbody>
</table>

LSD 5%

LSD: Earthing up (E) = 2.987; Fertilizer treatments (F) = 5.147; ExF = 5.0
Means having different letters differ significantly from each other by LSD at P = 0.05.

As regards interaction, significantly higher average cane yield (122.85 t/ha) was produced by E3F5 (earthing up at 120 DAP and 250-150-150 kg NPK/ha) than all other interaction except E3F4 with which it was at par (Table 4). E1F1 (no earthing up and no fertilizer) produced the lowest cane yield (47.29 t/ha).

REFERENCES


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