Effect of Cropping Methods and Salinity Stress on Wheat Agronomic Characteristics

1Mahdi Khozaei, 2Ali Soleimani, 3Amir Hosein Shirani, 4Payam Najafi and 4Mohammad Feizi
1Faculty of Agriculture, Khorasgan Azad University, Iran
2Department of Agronomy and Plant Breeding, Faculty of Agriculture, Islamic Azad University, Branch of Khorasgan, Iran
3Department of Soil and Water, Faculty of Agriculture, Islamic Azad University, Branch of Khorasgan, Iran
4Soil and Water Research Department, Ishan Agricultural and Natural Research Center, Iran

Abstract: Water deficit associate with salinity in irrigation water is the major limiting factor in the Center and East of Iran region. Nevertheless, an experiment was conducted in 2005 at Esfahan National Salinity Research. The purpose of this study was to evaluate effect of cropping methods and salinity stress on wheat agronomic characteristics. A Split plot layout within Randomized Complete Block Design with four replication were used. Irrigation quality water irrigation were in main plot, it consists in 4, 8 and 12 dS m\(^{-1}\) and cropping methods were in sub plots that inclusive of traditional cropping, 60 cm furrow, 80 cm furrow and aside sloping 80 cm furrow with double row planting. The results showed effect of raising salinity stress on 1000 grain weight, protein yield, grain yield, biological yield, straw yield and harvest index were decreased significantly. Effect of cropping methods on protein yield, biological yield and straw yield were more significantly. While, the highest amount of the traits agronomic were in 60 cm furrow cropping method, whereas the lowest the agronomic characteristics were in traditional cropping method with the exception of protein yield that lowest was in aside sloping 80 cm furrow. The effect of cropping methods on 1000 grain weight and harvest index were not significantly. According this study the suitable method with the highest traits agronomy in salinity stress was 80 cm method. While, the traditional cropping method did not recommended in high salinity stress condition.

Key words: Salinity stress, cropping method, harvest index, protein yield, grain yield

INTRODUCTION

Excess amount of salt in the soil adversely affects plant growth and development. Nearly 20% of the world’s cultivated area and nearly half of the world’s irrigated lands are affected by salinity (Zhu, 2001). Salinity is a major constraint to crop production in the arid and semiarid areas of the world, where low precipitation, high surface evaporation, irrigation with saline water, rising water tables and poor irrigation practices increase level of soluble salts (Ashraf, 1994; Hollington, 1998). Processes such as seed germination, seedling growth and vigor, vegetative growth, flowering and fruit set are adversely affected by high salt concentration, ultimately causing diminished economic yield and also quality of produce. Water deficit associated with salinity in irrigation water is the major limiting factor in the center and east of Iran where plants are subjected to extreme water deficit during the season. In this climatic condition, salts may accumulate in the soil because of low precipitation (Feizi, 1998). The detersive effect of salinity was suggested as result of water stress ion toxicities, ion imbalance, or combination of all these factors (Kurth et al., 1986). In view of, 55.8% of Iran’s lands contained sodic soil or insufficient draining; on the other hand, resource of irrigation water quality continued too much salts and ions (Keyani, 2001). It was necessity to investigation about usage new cropping methods in salinity stress in irrigated farming for cropping plants. Bernstein et al. (1955) done some research about seed bed and cropping methods in salinity stress, he showed distances between planting rows and furrow caused to lower detersive effect of ions and concentration of salts zone of root and stem. Also, rising seed bed could declined confronting of plant to direct side effect of salts toxicity. The aims of this study as regards geographical occasion of Iran, which established some arid and semi arid in center, east and north east with the minimum annual raining, to evaluate effect of cropping methods and salinity stress on wheat agronomic characteristics.

Corresponding Author: Mahdi Khozaei, Faculty of Agriculture, Islamic Azad University, Branch of Khorasgan, Khorasgan, Iran

2667
MATERIALS AND METHODS

This experiment was conducted in Esfahan National Salinity Research Rodasht Station with longitude 52/11' and latitude 32/29' in Oct, 2004. A split plot layout within Randomized Complete Block design with four Replications was used. Irrigation water qualities were in main plot, it consists in 4, 8 and 12 dS m⁻¹ cropping methods were in sub plot in collusive of traditional cropping, 60 cm furrow, 80 cm furrow. Aside sloping 80 cm furrow with double row planting. Measurement of plot was 32 m² with number of furrow 4, 5 in 80 and 60 cm furrow cropping methods respectively. The fertilizing were 100 kg ha⁻¹ ammonium phosphate before planting and 100 kg ha⁻¹ nitrogen in tow stage half before and half after planting used. After preparing Farm sown with seeds Wheat (Triticum aestivum, variety Roshan), then Physiological progress and development plant stage, gathered all products in every plot which weighed with the exception of margins to obtain biological yield. Then, sifting and cleaning so, seeds weighed to aim of grain yield. Obtained straw yield from Subtractd grain yield of biological yield. Counted 500 seed from every plot with seed counter Set then weighed and twofold it was seed weight. Eventually, harvest indices was estimated using below formula for every plot according to Lazar et al. (1995). Biological yield was considered as shoot dry weight,

\[ HI = \frac{\text{Seed yield}}{\text{Biological yield}} \times 100 \]

Statistical analyses of data were performed using MSTAT-C Program. Duncan Multiple Range Test was used to determine significant differences of means at the 5% level.

RESULTS AND DISCUSSION

Repeat affected was significantly on 1000 grain weight (Table 1). Effect of salts treatments on 1000 grain weight and harvest index was more significant (Table 1). Afzal (2004) reported Augmented salt levels caused deducted significantly on amount of kernel per spikes, grain weight per spikes and 1000 grain weight. Basically, seeds weight, controlled with period and filled up nutrient material rate. Also, amount of kernel per spikes (Kirby, 1974). Amount of 1000 grain weight and harvest index decreased significantly under the rising level of salt treatments (Table 2). Prakash et al. (2004) reported harvest index was reduced by 36 and 18%, at medium and high salinity levels, respectively. Rising salt levels affected directly on Harvest Index with declined 1000 grain weight. This result is in agreement with that of Housemand et al. (2005). Cropping methods did not affected significantly on 1000 grain weight and harvest index (Table 1). There were not any difference significantly between cropping methods on seed weight and harvest index (Table 2). Salinity reaction and methods cropping affected were not significant on seed weight and harvest index (Table 1). Effect of salt treatments was more significant on protein yield (Table 1). Thus, increasing salinity levels reduced significantly protein yield (Table 2). On the contrary, Francios et al. (1986) reported the rising salts treatment caused increasing in amount of protein in spite of, deducted in bread quality. Cropping methods affected was more significant on protein yield (Table 1). The highest protein yield was in 60 cm furrow cropping method while, the lowest was in sloping 80 cm furrow (Table 2). By this planting method soil and water salts still concentrate near the center of the bed but away from the seed rows and germination is likely to be better if salinity is a problem (Ayers and Westcot, 1985). Reaction of salt treatments and cropping methods affected were more significant on protein yield where as, the greatest depended on 60 cm furrow in salinity 4 dS m⁻¹ and the lowest belonged to 80 cm furrow in salinity 12 dS m⁻¹ there were not any significant difference between amount of protein yield in cropping methods in salinity 8, 12 dS m⁻¹ (Fig. 1). Excess of salt creates osmotic stress by a decline in water potential producing negative effect

Fig. 1: Means of comparison protein yield on reaction of salt treatments and cropping methods

2668
on physiology processes the same negative effect have also been reported by Sheveen et al. (2001). Effect of salt treatments on grain yield, biological yield and straw yield were more significant (Table 1). Raising salinity levels declined significantly amount of grain yield, biological yield and straw yield (Table 2).

Afzal (2004) reported salinity imposed with 20 $\text{dS m}^{-1}$ saline water reduced grain yield compared with control and 10 $\text{dS m}^{-1}$ saline water by 25 and 37%, respectively. Also, Afzal (2004) shown although, time of salinity treatment had not any significant effect on straw yield but any increasing in salinity levels, reduced straw yield significantly. Hasany et al. (1995) believed that raising salinity levels reduced significantly in biological yield. Cropping methods were more significant (Table 1) the greatest grain yield, biological yield and straw yield were in 60 cm furrow, though, the lowest of grain yield biological yield and straw yield were in sloping 80 cm furrow (Table 2). It seems the 60 cm furrow was suitable distance between planting rows which shown the highest yields because of distance encourage plant to growth and development procedure so, with the diminish of exceed ions and salts. Reaction of salinity and method cropping affected were more significant on grain yield, biological yield and straw yield (Table 1). The highest grain yield, biological yield and straw yield belonged to traditional cropping method in salinity 4 $\text{dS m}^{-1}$ in case, the lowest grain yield biological yield straw yield were in aside sloping 80 cm in salinity 12 $\text{dS m}^{-1}$ (Fig. 2-4). It seems in salinity 4 $\text{dS m}^{-1}$ were not any foes of ions and salts on growth development of plant. On the contrary, in salinity 12 $\text{dS m}^{-1}$ there were much force on stages of growth. Cerda and Bingham (1978) believed the reason of declined the grain yield and straw yield due of diminish amount of tillers and clusters. The greatest amount of grain yield, biological yield and straw yield in salinity 8, 12 $\text{dS m}^{-1}$ belong to 80 cm furrow then, 60 cm furrow cropping methods, respectively whereas, the lowest grain yield, biological yield and straw yield were in aside sloping 80 cm furrow. Creation distance between planting rows in salt treatments 8, 12 $\text{dS m}^{-1}$ reduction deteriorate and side effect as result of salt concentration on plant growth on

---

**Table 1: ANOVA analysis 1000 grain weight, harvest index, protein yield, grain yield, biological yield and straw yield**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>df</th>
<th>1000 grain weight (g)</th>
<th>Harvest index (%)</th>
<th>Protein yield (kg m(^{-2}))</th>
<th>Grain yield (kg ha(^{-1}))</th>
<th>Biological yield (kg ha(^{-1}))</th>
<th>Straw yield (kg ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Repeat (Block)</td>
<td>3</td>
<td>50.58***</td>
<td>61.516</td>
<td>6.4759</td>
<td>26.518</td>
<td>252.635</td>
<td>133.978**</td>
</tr>
<tr>
<td>Salinity</td>
<td>2</td>
<td>711.75**</td>
<td>19.3370**</td>
<td>407.462**</td>
<td>196.854**</td>
<td>11464.8**</td>
<td>3969.006</td>
</tr>
<tr>
<td>Error A</td>
<td>6</td>
<td>7.75</td>
<td>58.52</td>
<td>5.8564</td>
<td>23.233</td>
<td>100.123</td>
<td>32.55</td>
</tr>
<tr>
<td>Cropping method</td>
<td>3</td>
<td>17.917</td>
<td>50.841</td>
<td>7.8084**</td>
<td>50.393**</td>
<td>212.830**</td>
<td>54.739**</td>
</tr>
<tr>
<td>Interaction on salinity and cropping method</td>
<td>6</td>
<td>23.417</td>
<td>18.741</td>
<td>5.6363**</td>
<td>36.556**</td>
<td>234.089**</td>
<td>91.515**</td>
</tr>
</tbody>
</table>

**"** and * significant at the 5 and 1% probability levels, respectively.

**Table 2: Means comparison salt levels and cropping methods on 1000 grain weight, harvest index, protein yield, grain yield, biological yield and straw yield**

<table>
<thead>
<tr>
<th>Experimental factor</th>
<th>1000 grain weight (g)</th>
<th>Harvest index (%)</th>
<th>Protein yield (kg m(^{-2}))</th>
<th>Grain yield (kg ha(^{-1}))</th>
<th>Biological yield (kg ha(^{-1}))</th>
<th>Straw yield (kg ha(^{-1}))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salinity 4 $\text{dS m}^{-1}$</td>
<td>35.06a</td>
<td>41.46a</td>
<td>25.08a</td>
<td>759.40a</td>
<td>18320a</td>
<td>10730a</td>
</tr>
<tr>
<td>Salinity 8 $\text{dS m}^{-1}$</td>
<td>24.58b</td>
<td>34.94b</td>
<td>13.67b</td>
<td>2347.0b</td>
<td>6085b</td>
<td>3880b</td>
</tr>
<tr>
<td>Salinity 12 $\text{dS m}^{-1}$</td>
<td>22.63b</td>
<td>24.77b</td>
<td>3.883c</td>
<td>842.8c</td>
<td>2139c</td>
<td>1540c</td>
</tr>
<tr>
<td>Cropping methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Traditional cropping</td>
<td>27.42a</td>
<td>33.53ab</td>
<td>16.80bc</td>
<td>3243.0c</td>
<td>8277c</td>
<td>5218c</td>
</tr>
<tr>
<td>60 cm furrow method</td>
<td>28.50a</td>
<td>33.89ab</td>
<td>20.27a</td>
<td>4212.0a</td>
<td>10010a</td>
<td>6053a</td>
</tr>
<tr>
<td>80 cm furrow method</td>
<td>27.92a</td>
<td>36.55a</td>
<td>18.76ab</td>
<td>4632.0b</td>
<td>10000b</td>
<td>5845b</td>
</tr>
<tr>
<td>A side sloping 80 cm furrow method</td>
<td>27.67a</td>
<td>31.22b</td>
<td>14.35c</td>
<td>2890.0d</td>
<td>7111d</td>
<td>4418d</td>
</tr>
</tbody>
</table>

All means followed by the same letter in column are not significantly different at the 5% probability level.

![Graph](image-url)
the contrary, assembling salt and excessive ions between planting row of a side slopping 80 cm furrow caused risen osmotic pressure and declined up took mineral nutrients. Growth and development of plants are inhibited due to occurring defect in metabolism. Some investigators thought that because of ion accumulation by changing membrane permeability, metabolism was negatively in flounced (Cramer et al., 1985; Grieve and Fujiyama, 1987). In conclusion, with the rising salinity stress in arid and semi-arid where low precipitation, high surface evaporation, irrigation with saline water the ions and salts concentrated so, the beneficiary way was creates rising plant bed with the suitable distance to avoid of deteriorative effect. In present study in salinity 8, 12 dS m⁻¹ the best chosen was 80 cm furrow which showed the highest amount of agronomic characteristics.

REFERENCES


