Effects of Raised Bed Planting under Moist and Dry Soil Condition on Wheat Yield in North of Khuzestan, Iran

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ABSTRACT

Improving seed bed condition is one of the basic conditions for crop production. To examine new seeding methods included raised bed planting two different grain drills were designed. Also, to compare their effects on seedling emergence and finally wheat grain yield, an experiment was conducted using completely randomized block design with three replications in north of Khuzestan in 2009. Mold board plow with 25 cm depth followed by twice 10 cm depth disc harrows. Two methods of planting included moist and dry soil seeding by using grain drill equipped with fixed and spring loaded furrow openers were compared. The effects of space between the seeding rows and also beds of 60 and 75 cm were evaluated. The amount of 165 kg/ha wheat (Triticum aestivum L) was sown at 40 mm depth for all treatments. Analysis of the resulted data showed that moist planting using spring loaded furrow openers and raised bed by 75 cm distance between planting beds produced significantly (P<1%) higher grain yield and increased yield to 33% greater than flat planting. Conventional planting which did not put fertilizer under the seed bed, with flooding irrigation produced minimum amount of grain yield. Harvest index was significantly (P<1%) greater where planting methods and raised bed were compared. More grain yield was produced under moist (5467 kg/ha) compared to dry (4133 kg/ha) seeding conditions. Finally, The highest harvest index and grain yield were measured by using the 75 cm bed space.

Key words: Raised bed planting, Moisten soil, Grain drill, Wheat yield.

Introduction

Using advance methods for planting wheat will cause a balance in spreading seeds on the surface of field will lead to save seeds and decrease most of the problems beyond planting such as competition for using of water supplies and soil nutrients. The significance of using different plating methods for crop production was identified by attending the agro technique, economic and social situations[17,18,19]. Increasing production potential in the area of field, using of machinery technology can be effective in agricultural projects. In recent years using of planting techniques which prepare a suitable seed bed and plant seeds in apparently equaling depth is necessary (). Result of the combination of planting irrigation caused a decreased in percentage of the number of seeding in the area of field. [15] reported wheat variety in China investigated its yield on 2 ways of planting (raised bed and conventional planting) they reported that yield of raised bed planting would have increased by 20 percent. Freeman, [5] reported increase in raised planting system by means of creating a suitable drainage with the yield between 133 till 467 kg higher compared with conventional planting. Asoodar and Rahdar investigated seed

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effects of furrow and bed planting using the distance of 60 and 75 cm with 3 to 4 line planting on bed, using of furrow opener in the distance of 75 cm planting at the whole area of field (furrow and bed) would be the best planting treatment and increased the amount of yield compared with flat planting, on the other field using a furrower before the planting with the distance of 60 cm have shown the higher yield compared with working without furrowers. Duxbury [4] introduced wheat beds planting for increasing grain yield. Rafon [10], Jones and Jacobson [9] showed banding fertilizer compared with broadcasting increased the rate of production by 4%. According to this approaches that seeding wheat in the form of superficial and flooding irrigation was done, it's possible to use a suitable seeder, in order to work for wheat planting on bed. This research was conducted to investigate the effect of the mixture of the raised bed and seeding lines in rows in comparison with conventional planting and also the study performing yield under Khuzestan. The aims of the study were:

- Planting of seeds in a suitable depth with putting fertilizer below seeding depth.
- Choosing the most suitable sowing and irrigation systems for increasing wheat grain yield production.

**Materials and methods**

The experiment was conducted at Shuoshtar region (49° 14' E and 23° 2' N), 90 Km north of Ahvaz, at an average altitude of 670 m. The experiment field (pervious planting) in a 2 year alternative rotation was wheat, and wheat in order be in 2008-2009 was under wheat planting as well. The soil texture was silt and loom for the depth of 0 – 30 cm had possessed silt and loom texture with the electric conductivity (EC) 2/1 and PH 7.02.

The experimental design was performed in statistical split plot under randomized blocks design with 3 replications. Two levels of soil moisture known as moisten and dry condition selected as the main plots and three planting rows on the beds with the bed distance of 60 and 75 cm with fixed and spring loaded furrow openers as sub plots were the experimental design pattern. This experimental field divided into 27 plots and wheat planting pattern was sown in expected designed levels as follows.

**Testimonial:**

Conventional tillage (using leveler and disk) and assuming the fertilizer input according to soil, flood irrigation as conventional which most farmers used.

**Dry Condition:**

Using primary tillage and leveling was similar to previous. Furrowers were shaped at the same time as seed planting. The amount of assuming 165 kg/ha of seed using both 60 and 75 cm row space with 3 planting lines on each raised bed.

**Moisten Condition:**

By means of using furrowers in the field to shape the beds and irrigation was followed before seeding for making a seed bed with enough moisture to be used for crop to emergence without any more irrigation. At the time that soil moisture content was reached at the 14-18% it was ready for seeding the wheat (Atilla) seeds into the moisten soil. In both ways the date of planting was done according to the advice of research department at the ministry Jihad Keshavarzi.

**Seedling Emergence:**

The number of grown plants in one meter and on two planting lines (the middle row and one row beside it) was counted and inscription by using of the equation (1) to calculate the seedling emergence percentage (6).

\[
E = \frac{n_1}{n_2 \times v \times p} \times 100
\]

\(n_1\): the number of grown seeds  
\(n_2\): the number of planted seeds  
\(v\): the percentage of germination  
\(p\): the percentage of purity

**Speed of Emergence:**

The number of plants in 1 meter along the rows with the days after planting is according to the following equation (2).

\[
V = \frac{N_1 + N_2 + N_3 + ... N_n}{N_1T_1 + N_2T_2 + N_3T_3 + ... + N_nT_n} \times 100
\]

Where: \(V\) is the coefficient of velocity of seedling emergence, \(N_1, N_2, ..., N_n\) is the number of newly emerged seedling and \(T_1, ..., T_n\) is the number of days after sowing when the seedling were emerged.

**Grain Harvesting and Yield Components:**

After the harvesting was completed, the main parts of yield as the number of heads per one m\(^2\), the number of seeds in head, the weight of one hundred seeds, and finally grain yield were measured. For achieving of measuring data according to the method of sampling and harvesting, first 1m\(^2\) in 4 randomly
Replications was harvest by hand, then harvested biomass from the surface of the field was gathered for weight recording. Also the number head in each m² was counted, Heads of 20 plants were separated randomly and their seeds were counted, then their average in 20 heads as the number of seed per head, the weigh of seed with random samples was counted by three repetitions for each treatment.

Results and Discussion

Seedling Emergence:

Analysis of variance for the percentage of seedling emergence is shown in Table (1). It has shown the effect of planting methods, the distance between rows and the kind of furrow opener for seedling emergence percentage was significantly (P≥1%) greater where the moisten planting was conducted. The distance between row and the kind of furrow openers in percentage of seedling emergence figure (1) in dry soil conditions in both distances between rows 60 and 75 cm the emergence seeds were decreasing compared to moisten soil conditions.

The least amount of seedling emergence with the average of 60.1% percent was related to conventional planting and the highest rate of seedling emergence with the average of 83.4% was related to 75cm bed space row planting. This could be due to one of the effect of soil infiltration and low bulk density for the bed conditions. The effect of space between rows, 60 and 75 cm, the 60 cm row showed much better effect in soil moisture content and crop growth. To sum up in the moisten Soil, the emergence rate was significantly more than dry conditions, it might be due to be able to keep enough moisture for seed emergence without any new irrigation. These results are constant with finding report and observations of Sikhander et al.,[14] Sayre and Ramos [12].

Speed of Emergence:

According to table (1) the distance between rows and the furrow openers on speed of emergence was shown significantly (P<0.01) greater where seeds planted in moisten soil, and seeding methods and also seeding machineries. Figure (2) shows the speed coefficient of emergence with an average of 7 that related to sowing compare to conventional being about 6.2, the remain of higher soil moisture around seed depth area might be the reason of greater found seedling emergence speed for moisten planting systems. The emergence started at least 2 days faster where such a treatment was applied. The results which reported by Neshat[16] also was the same.

Grain Yield:

The effects of the planting types, distance between rows and the type of furrow openers were shown to be greater (P≥1%) on the number of heads, the comparison of planting treatment was shown a significant (P≥1%) effect on seedling percentage and also the speed of emergence. Figure (3) shown the significant effect of seedling in moisten soil compared to dry soil. The number of heads per square meter was also greater for seeding when the soil was moister. This general increasing might be due to the relationship of e polar effect on planting that that was moisten at the beginning of seeding for the 75 cm space rows. The number of heads was increased as well, these findings were related to the reports of Duxbury [4] and Wang [15]. Most of the number of heads per m² with the average of 457 heads relates to the conventional planting treatment, The most number of heads related to moisten condition for the space distance of 75 cm rows and using grain drills with spring loaded furrow openers. The cause of better Soil condition at the beginning of planting and increasing of the distance between planting line from 60 cm to 75 cm and the greater yield produced where the spring loaded opener was used. The percentage of seedling emergence and its speed at the beginning of the planting were higher. The effect on the increasing of the number of heads per m², the average number of 311 was measured for dry condition treatment where the 60 cm line and grain drill equipped with fix furrow openers.

1000 Seed Weight:

The effect of planting types, distance between rows and the type of furrow openers on the weigh of thousand seed average was significant (P≥1%), also for seedling emergence percentage measurements figure (4). Increasing of distance between rows of planting caused seeds that planted on moisten soil be able to produce higher one 1000 weight, it might be due to using of a new system that began with irrigation before seeding. The most seed thousand weight that shown in figure (4) related to sowing types and 75 cm row distance where spring loaded furrow openers were applied. This new seeding techniques and treatments would produce an average of 43 grams per 1000 seeds, possessed the most weigh of thousand seeds between all treatments. Therefore, the decreasing of the weigh of thousand seeds on conventional planting could be the existence of the number of head per m², this findings were shown related compatibility with the results of Duxbury, et al., [4].
Fig. 1: Effect of planting types, space between rows and furrow openers on seedling emergence.

Fig. 2: Effect of planting types, space between rows and furrow openers on speed of emergence.

Fig. 3: Effects of planting, space between rows and furrow openers on average head numbers m⁻².

Fig. 4: Effect of planting type, space between rows and furrow opener on 1000 seed weight.
Table 1: Analysis of variance for different characteristics at different growth stages under effects sowing methods.

<table>
<thead>
<tr>
<th>S.O.V</th>
<th>Df</th>
<th>Seedling emergence</th>
<th>Speed of emergence</th>
<th>Head /m²</th>
<th>Grain /head</th>
<th>1000 Seed weight</th>
<th>Biological grain yield</th>
<th>Grain yield</th>
<th>Harvest index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sowing method</td>
<td>8</td>
<td>193/29**</td>
<td>0/091**</td>
<td>6539/26**</td>
<td>171/65**</td>
<td>34/07**</td>
<td>4/399**</td>
<td>0/47**</td>
<td>34/39**</td>
</tr>
<tr>
<td>Replication</td>
<td>2</td>
<td>31/33</td>
<td>40543</td>
<td>51/815</td>
<td>16/41</td>
<td>5/64</td>
<td>0/22</td>
<td>0/25</td>
<td>1/34</td>
</tr>
<tr>
<td>Experimental error</td>
<td>16</td>
<td>68/92</td>
<td>0/003</td>
<td>311/704</td>
<td>13/07</td>
<td>2/69</td>
<td>0/11</td>
<td>0/01</td>
<td>0/77</td>
</tr>
</tbody>
</table>

* CV (%) 12/3 0/79 1/24 7/95 4/32 2/35 2/4 2/59

–, **: Significant at 5 and 1% probability levels, respectively.
ns: Not significant.

**Head Seed Number and Harvest Index (HI):**

Results have shown that the average number of seeds in heads is being great, table (1) that could be come from seedling emergence percentages and speed of emergence of wheat that number of the seed in heads was increased as shown in figure (5). This finding was confirm by Sikhander and coworkers who showed the number of seeds per head (20) would increase by using of suitable space between rows, also, the number of seeds per head was increased because of using furrowers instead of flat seeding.

Using sufficient space in moisten soil and bed planting in order to use more moisture for growing and also better infiltration for moisture penetration would be resulted in more grains in each head. Gupta (2002), Wang and coworkers (2004), shown the increasing of bed planting space From 30 cm to 45 cm would cause on increased seed number per head. The analyses of results for harvest index (HI) are shown in figure (6). The effects of planting type, bed space, and the type of furrow openers were shown a greater (P ≤ 1%) amount of HI, and harvest index significantly (P ≤ 1%) increased seed yield for moisten seeding condition.

**Yield and its Comparison with Conventional Planting:**

Figure (7) shows the average of grain yield for different treatments, the most yield of production was achieved (5467 kg/ha) where the moisten condition at sowing was applied. The space between rows was shown different effects on grain yield and 75 cm rows produced greater yield with comparison to 60 cm row space and then flat seeding respectively. Afzalinia et al., [3] reported similar results where bed planting was compared with flat seeding. So, the significantly (P ≤ 1%) least amount of grain yield (4133 kg/ha) was measured where the conventional planting was applied. Flood irrigation was one of the worse effect on grain yield production. John Heard [8] and Rehm [11] shown the similar results comparing bed planting versus flat irrigation on wheat grain yield.

**Conclusion:**

Raised bed planting and the space between rows could change the wheat seedling percentage and the speed of emergence of the seeds from the beginning of planting measurements. According to the calculating results of raised bed planting on seed numbers per head, heads per m² were greater (P ≤ 1%) than other treatment. Also grain yield and harvest index for raised bed planting using 75 cm row space was significantly (P ≤ 1%) greater (5467 kg/ha) compared to conventional treatment (4133 kg/ha). Grain yield was increased by 32% where the combination of moisten beds with 75 cm row space were applied. Also grain yield was increased for both bed planting treatments compared to flat seeding. These changes were 5% higher for 75 cm compared to 60 cm row space.

![Fig. 5: Seed numbers per head affected by planting, space between rows and furrow openers.](image-url)

Fig. 6: Harvesting index affected by planting type, space between rows and furrow openers.

Fig. 7: Grain yield produced using different planting type, furrow space and opener types.

References


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