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# Growth and yield attributes of wheat (*Triticum aestivum* L.) as influenced by lateral spacing with drip irrigation and nitrogen levels

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**Abstract**
A field experiment was conducted at the Regional Research Station, Anand Agricultural University, Anand, Gujarat during *rabi* season of 2015-16. The experiment comprised of eight treatment combinations with four drip lateral spacing (60, 80, 120 cm and conventional method) and two levels of nitrogen (100% and 75% RDN). The field experiment was laid out in split plot design with four replications. The growth and yield attributes were significantly higher in lateral spacing at 60 cm as compared to rest of the treatments but, they remained at par with 80 cm lateral spacing. Varying nitrogen levels had non-significant effect on growth and yield attributes except for number of spikelets spike$^{-1}$ where, significantly higher spikelets spike$^{-1}$were observed with 100% RDN. Non-significant influence of nitrogen levels was found on grain and straw yields.

**Keywords:** wheat, drip irrigation, lateral spacing, nitrogen levels

## Introduction
Wheat (*Triticum aestivum* L.) is one of the most important staple food grains of human race contributing substantially to the national food security. With increasing demand of wheat, it is important to work towards maximizing the productivity as there is no scope for increasing the area under production. Appropriate lateral spacing plays a very significant role in enhancing yield and managing cost. Considering the present scenario of water scarcity, emphasis should be given on use of more efficient methods of irrigation like drip irrigation. Along with increased irrigation efficiency, it is also important to provide optimum amount of nutrients to the crop. Nitrogen is the key element for plant growth and development, as it is a constituent of chlorophyll and proteins. Keeping this in view, the present investigation was undertaken to study the growth and yield attributes of wheat (*Triticum aestivum* L.) as influenced by lateral spacing with drip irrigation and nitrogen levels.

## Materials and Methods
A field experiment was carried out during *rabi* season of the year 2015-2016 at the Regional Research Station farm, Anand Agricultural University, Anand (22 $^{0}$ - 35' N, 72 $^{0}$ - 55' E and 45.1 m above the mean sea level), Gujarat. The soil was sandy clay with bulk density 1.43Mg m$^{-3}$, 0.24dSm$^{-1}$ EC and 7.7 soil pH, having good drainage. It was low in available nitrogen (237 kg ha$^{-1}$), medium in available phosphorus (50.34 kg ha$^{-1}$) and potassium (347 kg ha$^{-1}$). The experiment was laid out in split-plot design with four replications and eight treatment combinations with four lateral spacing (drip at 60, 80 and 120 cm and conventional method) and two levels of nitrogen (100% RDN and 75% RDN). Lateral spacing was assigned as main plot treatments and two nitrogen levels as sub-plot treatments. Wheat variety GW-496 was sown on 23 November, 2015 with seed rate of 120 kg ha$^{-1}$ at 20 cm row spacing. The plots were of size 4.8 m × 6 m and crop was raised with recommended package of practices. Irrigations were applied through drip irrigation based on 1.0 alternate day pan fraction evaporation (ADPEF). Laterals with emitters of 4 lph discharge capacity were installed at a spacing of 60, 80 and 120 cm and the distance between two emitters was 37. 5 cm. Total 45 irrigations of 372 mm were applied in drip treatments. Eight irrigations of 430 mm were given in the conventional method through irrigation channels. The daily pan evaporation values were measured with the help of USWB class 'A' open pan evaporimeter installed in the experimental field. The entire quantity of phosphorus (60 kg ha$^{-1}$) in the form of SSP along with 40 percent of nitrogen (as per treatment) in the form of urea was applied uniformly in the furrows as basal dose. The remaining 60 percent of nitrogen was applied in two equal splits as top dressing at 30 and 60 DAS.

The annual rainfall recorded during the growing season was 539 mm. however, there was no rain during experimental period. The biometric observations were recorded from five randomly selected plants tagged within each plot. Plant population at 20 DAS and periodical plant height at 15, 30, 60, 90 DAS and at harvest were recorded. Yield attributing characters like tiller conversion index, spike length, number of spikelets spike$^{-1}$, number of grains spike$^{-1}$ were calculated at the time of harvest. The crop was harvested manually with sickle when grains almost matured and straw had turned yellow and data on test weight, grain yield, straw yield and harvest index were recorded. The sun-dried bundles were threshed and winnowed and grains obtained were weighed. The straw yield was obtained by subtracting the grain yield from the biological yield.

## Results and Discussion

### Growth and yield attributes

The varying lateral spacing could not affect plant population at 20 DAS and plant heights at 15 and 30 DAS significantly, whereas, height increased significantly under 60 cm lateral spacing which remained at par with 80 cm spacing at 60 and 90 DAS and at harvest (Table 1). Lateral spacing showed significant influence on yield attributes *viz.*, tiller conversion index, spike-length, number of spikelets spike$^{-1}$, number of grains spike$^{-1}$ and test weight of grains. Yield attributes were significantly higher with lateral spacing of 60 cm as compared to rest of the treatments but it remained at par with 80 cm (Table 2). This might be due to uniform and adequate availability of water and better conducive rhizosphere for higher uptake of nutrients which in turn boost the growth, leading to the development of higher yield attributes through supply of more photosynthates towards the sink. Stress during the reproductive phase might have hampered the supply of photosynthates towards the sink resulting in poor yield attributes recorded in lateral spacing of 120 cm. These results are in close conformity with Chouhan *et al.* (2015) [1].

The effect of varying nitrogen levels was non-significant on growth and yield attributes *viz.* periodical plant heights, spike length, number of grains spike$^{-1}$, tiller conversion index and test weight but was significant on number of spikelets spike$^{-1}$ where, significantly higher spikelets spike$^{-1}$were observed with 100% RDN which might be due to higher photosynthetic activity of the plant as a result of higher level of nitrogen applied (Table 1 and 2). The non-significant influence maybe because when water is applied by drip irrigation, leaching losses of the nutrient is less and better utilization of applied nitrogen occurs. However, higher attributes with higher nitrogen dose was reported by Singh and Agarwal (2001) [3] and Tripathi *et al.* (2013) [4].

### Yields

Grain and straw yield were registered maximum under lateral spacing of 60 cm and 80 cm lateral spacing remained at par. Treatment 120 cm lateral spacing recorded the lowest grain and straw yield. Lateral spacing of 60 and 80 cm recorded 24.08 and 16.48 % higher grain yield and 13.96 and 9.51 % higher straw yield than conventional method, respectively (Table 2). Harvest index of wheat was obtained significantly higher under 60 cm lateral spacing which was at par with 80 cm lateral spacing. Higher grain yield was due to the cumulative effect of improvement in growth and yield attributes. It was also found that with sufficient moisture in the soil profile under higher irrigation frequency with drip irrigation, plant nutrient particularly nitrogen, phosphorus and potash were more available and might have translocated to produce more dry matter. Secondly, increase in yield might be due to more irrigations providing constant wetting of root zone which might have favoured greater release of nutrients from soil. Other reason might be due to increase in numbers of irrigation applied at shorter intervals and total consumptive use of water. These results are in conformity with the results of Chouhan *et al.* (2015) [1].

There was no significant effect of different nitrogen levels on grain and straw yields of wheat (Table 2).The reason for this might be due to better utilisation of even lesser quantity of applied nitrogen as a result of reduced leaching losses under drip irrigation system. Similar results were reported by Kachroo and Razdan, (2006) [2].

## Conclusion

In the light of the results obtained from the study conducted, it can be concluded that drip irrigation was found superior to conventional method. Irrigating wheat at 80 cm lateral spacing along with 75% RDN is better in terms of water saving along with better yield as it saves 14% water and gives 16.48% higher yield over conventional method.

**Table 1:** Plant population and growth attributes of wheat as influenced by levels of lateral spacing and nitrogen

| **Treatments** | **Plant population metre$^{-1}$ row length (20 DAS)** | **Periodical plant height (cm)** | | | | |
|---|---|---|---|---|---|---|
| Lateral spacing (S) | | **15 DAS** | **30 DAS** | **60 DAS** | **90 DAS** | **Harvest** |
| $S_1$ : 60 cm | 24.00 | 14.50 | 31.38 | 60.63 | 82.75 | 92.63 |
| $S_2$ : 80 cm | 22.25 | 14.25 | 32.00 | 55.57 | 78.63 | 89.58 |
| $S_3$ : 120 cm | 25.50 | 14.00 | 32.75 | 49.50 | 69.25 | 79.88 |
| $S_4$: conventional method | 23.00 | 13.88 | 31.50 | 52.00 | 74.13 | 83.63 |
| S.Em. ± | 0.99 | 0.66 | 1.19 | 1.58 | 1.74 | 2.54 |
| C.D. (P=0.05) | NS | NS | NS | 5.06 | 5.59 | 8.14 |
| Nitrogen (N) | | | | | | |
| $N_1$: 100 % RDN | 23.56 | 14.50 | 33.00 | 54.94 | 77.39 | 86.94 |
| $N_2$: 75 % RDN | 22.81 | 13.81 | 31.06 | 54.00 | 75.00 | 85.88 |
| S.Em. ± | 0.69 | 0.41 | 0.77 | 1.08 | 0.96 | 1.34 |
| C.D. (P=0.05) | NS | NS | NS | NS | NS | NS |
| S×N | Non-significant | | | | | |

**Table 2**: Yield attributes and yields of wheat as influenced by levels of lateral spacing and nitrogen

| Treatments | Tiller conversion index (%) | Spike length (cm) | Spikelets spike$^{-1}$ | Grains spike$^{-1}$ | Test weight (g) | Grain yield (kg ha$^{-1}$) | Straw yield (kg ha$^{-1}$) | Harvest index (%) |
|---|---|---|---|---|---|---|---|---|
| Lateral spacing (S) | | | | | | | | |
| $S_1$: 60 cm | 75.38 | 11.38 | 14.00 | 46.63 | 42.63 | 4869 | 5583 | 46.58 |
| $S_2$: 80 cm | 72.38 | 10.50 | 12.88 | 42.63 | 41.22 | 4571 | 5365 | 46.01 |
| $S_3$: 120 cm | 65.38 | 8.63 | 10.13 | 32.88 | 37.39 | 3396 | 4758 | 41.63 |
| $S_4$:conventional method | 68.88 | 9.88 | 12.25 | 39.88 | 39.46 | 3924 | 4899 | 44.49 |
| S.Em. ± | 2.06 | 0.42 | 0.61 | 1.35 | 0.86 | 185.60 | 173.90 | 0.55 |
| C.D. (P=0.05) | 6.62 | 1.36 | 1.98 | 4.32 | 2.75 | 593.74 | 556.31 | 1.76 |
| Nitrogen (N) | | | | | | | | |
| $N_1$:100% RDN | 70.94 | 10.44 | 13.06 | 40.88 | 40.48 | 4228 | 5178 | 44.76 |
| $N_2$: 75% RDN | 70.06 | 9.57 | 11.81 | 40.13 | 39.87 | 4152 | 5124 | 44.60 |
| S.Em. ± | 1.22 | 0.24 | 0.30 | 0.62 | 0.50 | 40.66 | 94.46 | 0.39 |
| C.D. (P=0.05) | NS | NS | 0.93 | NS | NS | NS | NS | NS |
| S×N | Non-significant | | | | | | | |

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