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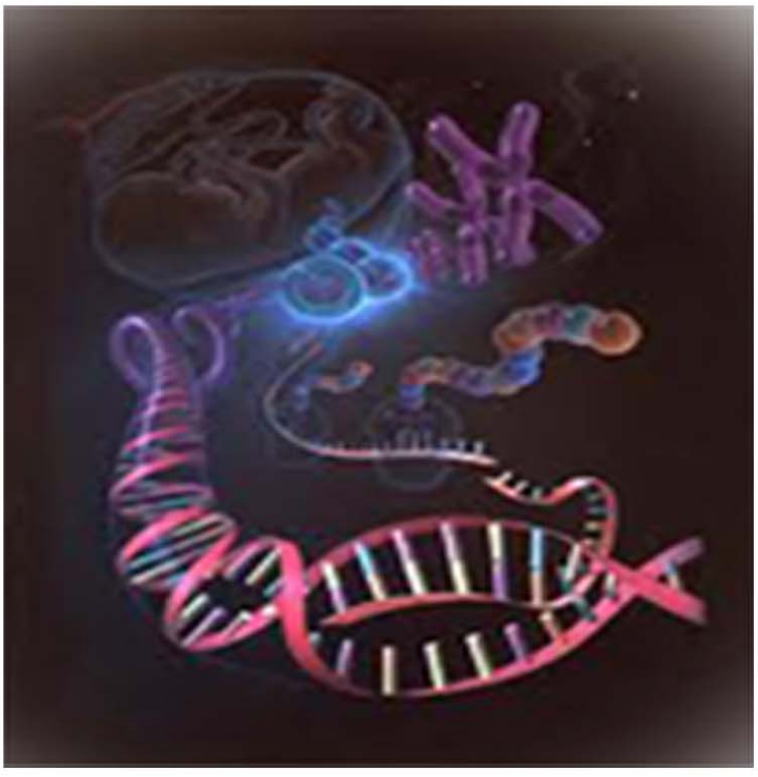

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*Research Paper*

# EFFECT OF ORGANIC SOURCES OF NUTRITION AND IRRIGATION LEVELS ON GROWTH AND YIELD OF WHEAT (*T. AESTIVUM*)

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A field experiment was conducted at CCS Haryana Agriculture University, Hisar during 2005-06 and 2006-07 to study the effect of organic sources of nutrition and irrigation levels on growth and yield of wheat. The plant height, dry matter accumulation, leaf area, CGR, LAI and LAD increased with increase in irrigation frequency. The results showed that the grain yield increased by 19.4 and 22.6% in $I_2$ over $I_1$ and 12.5 and 14.2% in $I_2$ over $I_3$ (3868 and 4060 kg/ha) during 2005-06 and 2006-07,respectively. All the growth parameters were found correlated with each other. The growth parameters namely plant height, leaf area, dry matter accumulation,CGR,LAI and LAD have significant positive relationship with grain yield during both the year. Plant height, leaf area, dry matter accumulation, CGR, LAI and LAD were significantly higher with poultry manure applied @ 225 kg N/ha over lower levels of all other organic sources of nutrition. Similarly increase in dose of organic manure from 75 to 150 and 225 kg N/ha by any sources increased the grain yield significantly during both the year. However, the grain yield of wheat was statistically at par with highest dose of 225 kg N/ha with three organic sources and with 150 kg N/ha applied through chemical fertilizer.

***Keywords:*** Organic sources, Irrigation levels, Growth, Yield, Wheat

## INTRODUCTION

Wheat (*Triticum aestivum L.*) is the most important food crop. It is grown all over the world for its wider adaptability and high nutritive value. In India, wheat is a predominant crop of North-Western Plain Zone and Centre Zone. The area, production and productivity of world is 225.4 m ha, 681.9 m tones, 3020 kg/ha; of India is 28.4 m ha, 80.7 m tones, 2840 kg/ha and of Haryana is 2.49 m ha, 6.33 m tones, 3933 kg/ha, respectively.The crop removes annually large quantities of plant nutrients from soil. The productivity and quality of a crop is controlled by many factors, of which the nutrition, especially nitrogen is the most important factor. Organic matter in soil improves soil structures, nutrient retention, aeration, soil moisture holding capacity

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and water infiltration (Deksissa *et al*.,2008). Although organic amendments can provide available nutrients for plants and nutrient transformation during organic matter decomposition strongly interacts with plant nutrient uptake, leading to a competition for nutrients between soil microorganisms and plants. Further, these systems are beneficial for the overall health of the agri-environment. Development and management of effective fertilization practices, such as by manipulating the quantity and type of organic amendments, improve soil ecosystems and fertility (Manqiang *et al*., 2009). Wheat is highly responsive to irrigation application. The potential yield of wheat can only be harvested by timely and judicious use of water. There are numerous reports in the literature that dryland crops are more nutritive than the produce of irrigated lands. Hence, harvesting of the quality grain needs adequate nutrient supply and irrigation. As both these inputs have synergistic interaction, it will be helpful in maintaining stability and sustainability of quality wheat production for our own consumption and export.

## MATERIALS AND METHODS

The experiment was conducted during 2005-06 and 2006-07 at the Agronomy Research Farm of Chaudhary Charan Singh Haryana Agricultural University, Hisar (India) located in Indo-Gangetic plains of North-West India with a latitude of $29^0$10' North and longitude of $75^0$46' East at 215.2 meters above mean sea level. The soil of the field was sandy loam, having 0.38% organic carbon and pH 7.96. It was low in available N (160.7 kg/ha), medium in available P (8.4 kg/ha) and rich in available K (314.6 kg/ha). The treatments consisted of 3 level of irrigation in main plot i.e., 2, 3 and 4 irrigation and 11 treatments of nutrition, viz. control, recommended dose of chemical fertilizer, FYM equal to 75kg N/ha, FYM equal to 150kg N/ha, FYM equal to 225kg N/ha, vermi-compost equal to 75kg N/ha, vermi-compost equal to 150kg N/ha, vermi-compost equal to 225kg N/ha and poultry manure equal to 75kg N/ha poultry manure equal to 150kg N/ha poultry manure equal to 225kg N/ha. These treatments were tested in strip plot design with four replication. The organic sources were applied 15 days before sowing and incorporated through land preparation in the soil as per treatment. The recommended dose of nitrogen was applied in the form of urea. Half dose of the recommended nitrogen was applied as basal dose and remaining half as top dressing after 1st irrigation during both the seasons. Wheat cv. WH 283 was sown with the help of seed drill in rows 20 cm apart at the rate of 125kg/ha. Crop was sown on 5th and 2nd December during the first and second year of the experimentation. Irrigation was applied in the field as per treatments. The weeds were removed by long tine hoe at 40 days and later by hand pulling. All the growth parameters were recorded at 30 days interval till crop maturity. The yield was recorded at maturity of the crop.

## RESULTS AND DISCUSSION

### Growth

The LAI increased significantly with increase in irrigation levels during both the years of experimentation (Table 1). Maximum LAI was recorded with highest level of irrigation i.e. 4 irrigations at 22, 45, 85 and 105 days in wheat, which differed significantly from 2 irrigations ($I_1$) at all the stages except at 30 days in both the years. However, the difference was non significant between $I_1$ and $I_2$ at 60 and 90 days in both the years. The leaf area duration was increased

**Table 1: Effect of Different Sources of Nutrition and Irrigation Levels on Leaf Area Index (LAI) of Wheat**

| Treatments | Days after sowing | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 30 | | 60 | | 90 | | 120 | |
| | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 |
| $I_1$ | 0.46 | 0.49 | 2.34 | 2.35 | 3.43 | 3.52 | 2.55 | 2.70 |
| $I_2$ | 0.47 | 0.49 | 2.41 | 2.50 | 3.59 | 3.67 | 2.74 | 2.83 |
| $I_3$ | 0.48 | 0.50 | 2.55 | 2.67 | 3.67 | 3.75 | 2.95 | 3.04 |
| CD at 5% | 0.05 | 0.06 | 0.18 | 0.15 | 0.12 | 0.10 | 0.27 | 0.25 |
| $T_1$ | 0.28 | 0.35 | 1.31 | 1.36 | 2.73 | 2.77 | 2.12 | 2.18 |
| $T_2$ | 0.60 | 0.61 | 2.95 | 3.06 | 4.10 | 4.20 | 3.23 | 3.49 |
| $T_3$ | 0.36 | 0.37 | 2.05 | 2.10 | 3.10 | 3.13 | 2.27 | 2.40 |
| $T_4$ | 0.45 | 0.46 | 2.52 | 2.62 | 3.51 | 3.60 | 2.83 | 2.81 |
| $T_5$ | 0.52 | 0.53 | 2.81 | 2.91 | 4.00 | 4.10 | 3.08 | 3.17 |
| $T_6$ | 0.40 | 0.41 | 2.07 | 2.13 | 3.18 | 3.22 | 2.42 | 2.49 |
| $T_7$ | 0.51 | 0.52 | 2.53 | 2.63 | 3.63 | 3.73 | 2.76 | 2.84 |
| $T_8$ | 0.55 | 0.57 | 2.90 | 3.00 | 4.04 | 4.14 | 3.10 | 3.19 |
| $T_9$ | 0.42 | 0.46 | 2.14 | 2.23 | 3.19 | 3.25 | 2.42 | 2.64 |
| $T_{10}$ | 0.52 | 0.53 | 2.55 | 2.65 | 3.68 | 3.78 | 2.85 | 2.96 |
| $T_{11}$ | 0.56 | 0.59 | 2.90 | 2.92 | 4.05 | 4.16 | 3.17 | 3.25 |
| CD at 5% | 0.04 | 0.07 | 0.20 | 0.16 | 0.17 | 0.18 | 0.26 | 0.25 |

significantly with successive increase in irrigation levels during both the years of experimentation. Maximum LAD was recorded with highest level of irrigation ($I_3$) which differed significantly from 2 irrigations ($I_1$) at all the stages except at 30 days in both the years (Table 2). However, the difference was non significant between $I_1$ and $I_2$ at 91-120 days and 121 days to maturity in both the years. The CGR was significantly affected by irrigation levels during both the years (Table 3). The successive increase in irrigation levels significantly increased the CGR at all the growth stages during both the years. Whereas, maximum CGR was observed in $I_3$, which was significantly greater than $I_1$ and at par with $I_2$.

The plant height increased significantly with successive increase in irrigation levels in both the years of experimentation (Table 4). Maximum plant height was recorded with 4 irrigations ($I_3$), which differed significantly from 2 irrigations ($I_1$) in both the years. However, the difference were non significant between $I_1$ and $I_2$ during both the years. $I_2$ and $I_3$ had significantly higher dry matter accumulation than $I_1$ in both the years. Further, 4 irrigations produced significantly higher dry matter as compared to 3 irrigations at 22, 65 and 105

**Table 2: Effect of Different Sources of Nutrition and Irrigation Levels on Leaf Area Duration (Days) of Wheat**

| Treatments | Days after sowing | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-30 | | 31-60 | | 61-90 | | 91-120 | | 121-maturity | |
| | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 |
| $I_1$ | 6.92 | 7.29 | 42.0 | 42.6 | 86.5 | 88.1 | 89.7 | 93.2 | 20.4 | 22.9 |
| $I_2$ | 6.99 | 7.32 | 43.1 | 44.8 | 90.0 | 92.5 | 95.0 | 97.5 | 22.0 | 24.1 |
| $I_3$ | 7.25 | 7.47 | 45.5 | 47.5 | 93.3 | 96.3 | 99.4 | 101.8 | 23.6 | 25.8 |
| CD at 5% | 0.69 | 0.91 | 3.1 | 2.1 | 4.4 | 3.2 | 4.8 | 4.4 | 2.1 | 2.1 |
| $T_1$ | 4.20 | 5.19 | 23.9 | 25.5 | 60.6 | 61.9 | 72.7 | 74.3 | 17.0 | 18.5 |
| $T_2$ | 8.99 | 9.14 | 53.3 | 55.1 | 105.8 | 109.0 | 110.0 | 115.4 | 25.9 | 29.6 |
| $T_3$ | 5.40 | 5.55 | 36.2 | 37.1 | 77.3 | 78.5 | 80.5 | 83.1 | 18.1 | 20.4 |
| $T_4$ | 6.75 | 6.94 | 44.5 | 46.2 | 90.4 | 93.3 | 95.2 | 96.1 | 22.7 | 23.8 |
| $T_5$ | 7.80 | 8.02 | 50.0 | 51.6 | 102.2 | 105.1 | 106.2 | 109.0 | 24.6 | 26.9 |
| $T_6$ | 6.00 | 6.17 | 37.0 | 38.1 | 78.7 | 80.2 | 84.0 | 85.7 | 19.4 | 21.2 |
| $T_7$ | 7.65 | 7.86 | 45.7 | 47.3 | 92.5 | 95.3 | 95.9 | 98.5 | 22.1 | 24.1 |
| $T_8$ | 8.25 | 8.48 | 51.8 | 53.5 | 104.1 | 107.1 | 107.1 | 109.9 | 24.8 | 27.1 |
| $T_9$ | 6.30 | 6.85 | 38.4 | 40.3 | 80.0 | 82.2 | 84.2 | 88.4 | 19.4 | 22.5 |
| $T_{10}$ | 7.85 | 7.93 | 46.1 | 47.6 | 93.5 | 96.3 | 97.9 | 101.0 | 22.8 | 25.1 |
| $T_{11}$ | 8.43 | 8.83 | 52.0 | 52.6 | 104.3 | 106.2 | 108.3 | 111.2 | 25.3 | 27.6 |
| CD at 5% | 0.59 | 0.98 | 3.2 | 2.6 | 4.7 | 4.2 | 4.7 | 5.2 | 2.1 | 2.1 |

days of wheat at in both the years. The plant growth in terms of height, dry weight accumulation, leaf area, LAI, LAD and CGR was significantly higher under $I_3$ during both the year in later stage of crop growth was because of more water availability to the crop plants. The maximum leaf area per plant recorded at 90 days was increased with increase in irrigation frequency. The per plant leaf area was significantly higher in $I_2$ and $I_3$ over $I_1$. But the difference in leaf area was non-significant between $I_2$ and $I_3$ treatment. The higher amount of available water kept the higher turgor potential, which lead to higher rate of photosynthesis due to more opening of stomata for longer period of time. Similar findings were also recorded by Kibe and Singh, 2003 and Pannu and Sharma, 2004.

Application of organic sources of nutrition also influenced the LAI significantly at all the stages of growth except 30 days during two years of study (Table 1). Maximum LAI was recorded with recommended dose of fertilizers ($T_2$), which differed significantly from control and lower doses of organic sources of nutrition ($T_3$, $T_4$, $T_6$, $T_7$, $T_9$ and $T_{10}$), while, it was at par with higher doses of organic sources ($T_5$, $T_8$, and $T_{11}$) during both the years. Application of organic sources of nutrition

also influenced the LAD significantly at all the stages of growth except 30 days in both the years. Maximum LAD was recorded with recommended dose of fertilizers ($T_2$), which differed significantly from control and lower doses of organic sources of nutrition ($T_3$, $T_4$, $T_6$, $T_7$, $T_9$ and $T_{10}$), while, it was at par with higher doses of organic sources ($T_5$, $T_8$, and $T_{11}$) during both the years (Table 2). The crop growth rate was maximum and significantly higher than control at recommended dose of nutrient through chemical fertilizers ($T_2$) at all the stages, but, at par with organic sources applied @ 150 and 225 kg N/ha at later stages of crop growth in both the years (Table 3). The CGR become statistically at par between all the three levels of FYM and upper two levels of vermi-compost and poultry manure with that of recommended dose of fertilizer. The application of organic sources of nutrition also influenced the plant height significantly at all the stages of growth except 30 days in both the years (Table 4). Highest plant height was recorded with recommended dose of fertilizers (150 and 60 kg/ha N and $P_2O_5$, respectively), which differed significantly from control and lowest doses of organic sources of nutrition ($T_3$, $T_6$ and $T_9$), while it was at par with 150 and 225 kg N/ha doses of organic sources ($T_4$, $T_5$, $T_7$, $T_8$, $T_{10}$ and $T_{11}$) during

**Table 3:Effect of Different Sources of Nutrition and Irrigation Levels on Crop Growth Rate (Cgr, G/M2/Day) of Wheat**

| Treatments | Days after sowing | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0-30 | | 31-60 | | 61-90 | | 91-120 | | 121-maturity | |
| | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 |
| $I_1$ | 0.42 | 0.45 | 1.71 | 1.75 | 1.52 | 1.63 | 1.38 | 1.42 | 0.64 | 0.65 |
| $I_2$ | 0.43 | 0.44 | 1.77 | 1.85 | 1.68 | 1.83 | 1.43 | 1.49 | 0.77 | 0.82 |
| $I_3$ | 0.42 | 0.45 | 1.86 | 1.95 | 1.79 | 1.92 | 1.47 | 1.55 | 0.83 | 0.94 |
| CD at 5% | NS | NS | 0.15 | 0.13 | 0.27 | 0.20 | 0.06 | 0.07 | 0.17 | 0.27 |
| $T_1$ | 0.39 | 0.42 | 1.51 | 1.57 | 1.66 | 1.72 | 1.31 | 1.34 | 0.35 | 0.22 |
| $T_2$ | 0.46 | 0.47 | 2.05 | 2.18 | 1.93 | 1.98 | 1.54 | 1.59 | 1.05 | 1.04 |
| $T_3$ | 0.41 | 0.42 | 1.51 | 1.57 | 1.49 | 1.54 | 1.37 | 1.40 | 0.73 | 0.75 |
| $T_4$ | 0.42 | 0.43 | 1.76 | 1.83 | 1.62 | 1.67 | 1.42 | 1.46 | 0.87 | 0.90 |
| $T_5$ | 0.42 | 0.45 | 1.96 | 2.02 | 1.75 | 1.80 | 1.46 | 1.50 | 0.92 | 0.92 |
| $T_6$ | 0.42 | 0.43 | 1.58 | 1.65 | 1.51 | 1.67 | 1.39 | 1.45 | 0.49 | 0.53 |
| $T_7$ | 0.42 | 0.45 | 1.79 | 1.85 | 1.59 | 1.86 | 1.43 | 1.52 | 0.61 | 0.64 |
| $T_8$ | 0.43 | 0.46 | 1.98 | 2.09 | 1.72 | 1.94 | 1.46 | 1.55 | 0.99 | 0.99 |
| $T_9$ | 0.42 | 0.44 | 1.58 | 1.64 | 1.58 | 1.69 | 1.38 | 1.46 | 0.55 | 0.95 |
| $T_{10}$ | 0.43 | 0.45 | 1.80 | 1.86 | 1.67 | 1.89 | 1.45 | 1.52 | 0.66 | 0.87 |
| $T_{11}$ | 0.44 | 0.46 | 2.02 | 2.09 | 1.76 | 1.97 | 1.49 | 1.56 | 1.04 | 1.03 |
| CD at 5% | NS | NS | 0.24 | 0.25 | 0.26 | 0.23 | 0.10 | 0.13 | 0.46 | 0.52 |

**Table 4: Effect of Different Sources of Nutrition and Irrigation Levels on Growth and Yield of Wheat**

| Treatment | GrowthGrain yield (kg/ha)Pooled (kg/ha)Harvest Index (%) | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Plant Height (cm) | | Dry Weight (g/m$^2$) | | Max. Leaf Area (cm$^2$/m$^2$) | | Grain yield (kg/ha) | | Pooled (kg/ha) | Harvest Index (%) | |
| | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 | 2005-06 | 2006-07 | | 2005-06 | 2006-07 |
| $I_1$ | 88.5 | 90.8 | 8.96 | 9.37 | 381 | 391 | 3239 | 3311 | 3275 | 42.0 | 41.4 |
| $I_2$ | 90.5 | 92.3 | 9.52 | 10.11 | 399 | 408 | 3643 | 3782 | 3713 | 42.0 | 41.8 |
| $I_3$ | 93.9 | 95.4 | 9.98 | 10.67 | 408 | 417 | 3868 | 4060 | 3964 | 43.4 | 42.5 |
| CD at 5% | 3.7 | 3.2 | 0.27 | 0.30 | 13 | 11 | 107 | 107 | 57 | NS | NS |
| $T_1$ | 81.2 | 83.5 | 8.38 | 8.53 | 303 | 308 | 2492 | 2592 | 2542 | 38.6 | 38.9 |
| $T_2$ | 94.3 | 96.9 | 10.88 | 11.36 | 456 | 467 | 4113 | 4218 | 4166 | 43.7 | 42.8 |
| $T_3$ | 89.4 | 91.9 | 8.61 | 8.93 | 344 | 348 | 3071 | 3249 | 3160 | 41.8 | 40.9 |
| $T_4$ | 91.2 | 93.8 | 9.49 | 9.86 | 390 | 400 | 3617 | 3765 | 3691 | 43.4 | 41.5 |
| $T_5$ | 93.1 | 94.7 | 10.13 | 10.49 | 444 | 456 | 3906 | 4012 | 3959 | 43.2 | 42.2 |
| $T_6$ | 90.2 | 91.9 | 8.61 | 9.19 | 353 | 358 | 3236 | 3347 | 3291 | 41.5 | 41.4 |
| $T_7$ | 91.5 | 93.2 | 9.27 | 10.08 | 403 | 414 | 3745 | 3849 | 3797 | 43.6 | 42.0 |
| $T_8$ | 93.1 | 94.9 | 10.22 | 11.00 | 449 | 460 | 3914 | 4183 | 4048 | 43.3 | 43.2 |
| $T_9$ | 91.4 | 91.8 | 8.78 | 9.62 | 354 | 361 | 3366 | 3451 | 3409 | 41.9 | 41.8 |
| $T_{10}$ | 92.2 | 93.4 | 9.51 | 10.38 | 409 | 420 | 3828 | 3959 | 3894 | 42.7 | 42.9 |
| $T_{11}$ | 93.2 | 95.1 | 10.44 | 11.12 | 450 | 462 | 4130 | 4269 | 4199 | 43.2 | 43.3 |
| CD at 5% | 5.2 | 4.6 | 0.41 | 0.48 | 19 | 20 | 230 | 179 | 137 | 3.4 | 2.8 |

both the years at harvest. The dry matter accumulation in plant increased significantly with recommended dose of fertilizers (150 and 60 kg/ha, N and $P_2O_5$, respectively), which differed significantly from control ($T_1$) and lower doses (75 kg N/ha) of organic sources of nutrition. Further, the differences in dry matter accumulation values were non significant between $T_2$ and $T_{11}$ at all the growth stages during both the years of study except at maturity during 2005-06. The leaf area per plant increased significantly with increase in N level among all the sources of nutrition. The leaf area was statistically at par in recommended dose of chemical fertilizer ($T_2$) with higher dose of 225 kg/ha in all the sources of nutrition. The growth parameters were found correlated with each other with a correlation coefficient of (r=0.74 and 0.84) for plant height and dry matter accumulation (r=0.85 and 0.87) for plant height and leaf area during two year of the study. This indicate that instead of recording all the growth parameters, anyone can be recorded. Nitrogen being the basic constituent of chlorophyll, protein and cellulose required for the process of photosynthesis and tissue buildup for proper growth. The growth at higher level of nitrogen application i.e., 225 kg N/ha applied through different organic sources were

increased significantly and it was maximum in recommended dose of chemical fertilizer. This indicate that the organic sources have supplied the nitrogen to the crop plant slowly and their availability may also be less than the recommended dose of chemical fertilizer which was readily available. This fact of slow release can further be substantiated from all the growth parameters recorded higher during second year of study. Reger, *et al*., 2005 and Nag, *et al*., 2006 also reported similar effect of organic sources of nutrition on growth of wheat.

## YIELD AND HARVEST INDEX

The application of irrigation significantly enhanced the grain yield of wheat in both the years (Table 4). The maximum grain yield (3868 and 4060 kg/ha) was obtained with four irrigations, which was significantly higher as compared to two and three irrigations during first and second year, respectively. The harvest index of wheat was not influenced by the different levels of irrigation in both the year. Yield of wheat increased with increase in irrigation frequency from $I_1$ to $I_3$ because of higher crop growth in $I_3$. The irrigation frequency did not cause any variation in harvest index of wheat crop. Similar results were observed by Shiwani *et al*., 2003 and Ingle *et al*., 2007.

Pronounced effect of nutrient application through organic sources was observed on the grain yield of wheat during both the years of experimentation. There was significant increase in grain yield due to application of different sources of nutrients (FYM, vermi-compost, poultry manure and fertilizers) over control. Further, application of poultry manure equal to 225 kg N/ha ($T_{11}$) being at par with recommended dose of fertilizers ($T_2$) and vermi-compost equal to 225 kg N/ha ($T_8$) in both the year and FYM equal to 225kg N/ha in first year only. However, poultry manure @ 225 kg N/ha ($T_{11}$) recorded significant increase in yield over poultry manure equal to 75 kg N/ha ($T_9$) and 150 kg N/ha ($T_{10}$), vermi-compost equal to 75 kg N/ha ($T_6$) and 150 kg N/ha ($T_7$), FYM equal to 75 kg N/ha ($T_3$) and 150 kg N/ha ($T_4$) in both the years.

Application of treatments $T_2$, $T_3$ $T_4$, $T_5$, $T_6$, $T_7$, $T_8$, $T_9$ $T_{10}$ and $T_{11}$ increased 63.9, 24.3, 45.2, 55.7, 29.5, 49.4, 59.2, 34.1, 53.2 and 65.2% grain yield over Control ($T_1$). Higher level of FYM ($T_5$) increased grain yield by 25.3 % over lower level ($T_3$) and 7.3 % over medium level ($T_4$). Higher level of vermi-compost ($T_8$) increased grain yield by 23.0 % over lower level ($T_6$) and 6.6 % over medium level ($T_7$). Poultry manure @ 225 kg N/ha ($T_{11}$) increased grain yield by 23.2 % over 75 kg N/ha ($T_9$) and 7.8 % over 150 kg N/ha ($T_{10}$). Similar results were observed by Channabasanagowda *et al*., 2008 and Hammad *et al*., 2011.

Application of recommended dose of fertilizer ($T_2$) being at par in harvest index with all the levels of organic sources and significant over the control during both the years. Application of poultry manure equal to 225 kg N/ha ($T_{11}$) being at par in harvest index with $T_2$, $T_3$ $T_4$, $T_5$, $T_6$, $_7$, $T_8$, $T_9$ and $T_{10}$, but increased significantly over control. However, the difference in harvest index of wheat grown in $T_1$, $T_3$, $T_4$, and $T_6$ treatment were non-significant. All the growth parameters were found correlated with grain yield with a correlation coefficient of (r=0.93 and 0.93) for grain yield and plant height, (r=0.90 and 0.96) for grain yield and dry matter accumulation, (r=0.97 and 0.97) for grain yield and leaf area, (r=0.97 and 0.97) for grain yield and leaf area index, (r=0.97 and 0.97) for grain yield and leaf area duration, (r=0.89 and 0.96) for grain yield and crop growth rate during both the year. The significant positive correlation

of different growth parameters with yield indicate that for higher yield good growth is essential. Similarly, significant positive association among growth parameters and growth indices was observed as these indices were calculated from the growth data. Poor nutrition in control and lower dose of organic sources leads to poor growth as reflected in plant height, dry matter accumulation and leaf area, and poor partitioning in economic plant part, i.e., grain. Since, grain being rich in protein requires more N for its growth and development than crop straw. Similar results were observed by Kharub and Chander, 2008, and Rani *et al*., 2009. Poultry manure was reported the best source among the all organic sources because of higher concentration of N that is readily available to crop. The better response of poultry manure over other sources may be because of higher approximately 40% of total N in poultry manure in available form has been reported by Shepherd and Withers (1999).

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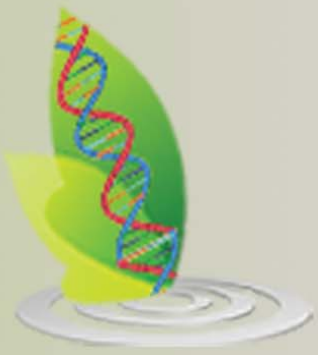

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