INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

www.ijabpt.com ISSN : 0976-4550

*Volume-6, Issue-3, July-Sept-2015* *Coden IJABFP-CAS-USA* *Copyrights@2015*

*Received: 9th July-2015* *Revised: 22nd July -2015* *Accepted: 24th July-2015*

***Review article***

# "RESPONSE OF DIFFERENT WHEAT (*Triticum aestivum* L.) VARIETIES TO GRADED LEVELS OF NITROGEN" - A Critical review

M.Satyanarayana

Agricultural Officer (Irrigation and Labor operations), FETS - Farm services, ICRISAT, Patancheru
Tel : +91-40-30713405, Mob: +91-7032823405

Wheat is the most important and widely cultivated food crop in the world. In India, Wheat is the second important cereal crop, first being Rice. To improve the production of wheat, as in any other crop, introduction of varieties with a high yield potential is essential. Variety contributes more than 50 percent of the increased production. The next important component for increased production is the nutrient availability. Native fertility level of the tropical soils with special reference to nitrogen is invariably insufficient for touching the peak production mark of a variety and hence, the need for supplementing this nutrient is obvious with most varieties. Selection of suitable genotype is of prime importance as the genetic potential of varieties limits response to nitrogen. Moreover, varieties differ both in yield and nutrient uptake. Hence, it is necessary to find out the correct dose of nitrogen and suitable varieties for maximizing wheat yields in Southern Telangana agro-climatic zone.

## Review

The literature pertinent to the present study on "Response of different wheat (*Triticum aestiuvm*) varieties to graded levels of nitrogen" has been briefly reviewed in this chapter.

## PERFORMANCE OF WHEAT VARIETIES ON GROWTH AND YIELD PARAMETERS

### Growth characters

### Plant height

Bastia D K and Rout A K (2001) reported that the plant height was maximum with 'Sonalika' followed by 'OW 6' on a shallow black soil during the winter season of 1998-99 and 1999-2000 at Bhawanipatna, Kalahandi, Orissa.

Jat and Singhi (2004) reported that amongst varieties, 'Raj 3077' bread wheat produced significantly higher plant height (88.8cm) during the winter season-summer season of 1998-2000 on clay loam soil at Udaipur, Rajasthan.

Shahzad Ali Bannori *et al.* (2005) reported that variety Tatara-96 attained maximum plant height of 122 cm, while lowest plant height of 85 cm was attained by variety Fakhr-e-Sarhad during 1998-99 at Malkandher Research Farm, NWFP Agricultural University, Peshawar (Pakistan).

The variety 'HP 1744' attained maximum plant height (91.2cm) on clay loam soil during *rabi* season of 2000-01 and 2001-02 at Pusa, Bihar (Pandey et al. 2008).

### Leaf area index

Srinivas (2002) reported that the variety HD-5402 was at par with HD-2189 at 30, 70 and 90 DAS during first year and it recorded significantly higher leaf area index than rest of two varieties (HD-2189 and HD-2180) at 70 and 90 DAS during second year on sandy loam soil during winter season of 1987-88 at College of Agriculture Farm, Rajendranagar, Hyderabad.

The maximum leaf area index (4.1) at heading was recorded by HI 8498 durum wheat during winter season-summer season of 1998-2000 on clay loam soil at Udaipur, Rajasthan (Jat and Singhi 2004).

Muhammad Aslam Khan *et al.* (2005) reported that the highest leaf area indices were observed in cultivar Inqlab-91 (1.13 and 2.17) and the lowest in Panjnad-1 (0.42 and 0.67) at 64 and 71 days after sowing respectively under saline conditions at the University College of Agricultural Research Farm, Bahauddin Zakariya University, Multan (Pakistan).

### Dry matter accumulation (kg ha$^{-1}$)

Satish Kumar *et al.* (1998) reported that the shoot dry matter of HD-2329 was significantly higher at 30 and 60 DAS however, at 120 DAS it was significantly lower than WH-542, WH -543 on sandy loam soil during *rabi* seasons of1994-95 and 1995-96 at Regional Station, Rohtak, Haryana.

Purshotam Singh *et al.* (2010) reported that Shalimar wheat 1 registered higher dry matter at harvest (13.37 t ha$^{-1}$) on silty clay loam soil during winter season of 2005-06 at RRS and FOA, Wadura of Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir.

### Growth functions

The variety HD-4502 in both the years (1987 and 1988)showed significantly higher leaf area duration (75.31 m$^2$ day$^{-1}$ and 58.72 m$^2$ day$^{-1}$) at 70 days after sowing over HD 2189 and HD 2281 on sandy clay loam soil, Rajendrangar, Hyderabad (Srinivas, 2002).

Muhammad Aslam Khan *et al.* (2005) reported that the cultivars Drawar-97 (155.0 g kg$^{-1}$day$^{-1}$) and Manthar-3 (188.2 g kg$^{-1}$day$^{-1}$) showed highest relative growth rates at 50 and 57 DAS respectively. The cultivars BPW-97(899.1 and 918.8 g/cm$^2$/day) and Panjnand-1(1168.0 g/cm$^2$/day) showed the highest net assimilation rates at 50 and 64 DAS, respectively under saline conditions at the University College of Agricultural Research Farm, Bhauddin Zakariya University, Multan (Pakistan, 2005).

### YIELD PARAMETERS (Number of tillers per meter row length, ears m$^{-2}$, grains per ear and length of ear)

Singh *et al.* (1997) reported that the varieties HUW-324 and K-8020 recorded significantly more number of spikes per metre row length (49.4 and 46.9) and grains per spike (45.3 and 41.3) respectively during the winter season of 1990-91 at Kanpur.

Gupta *et al.* (1998) reported that effective tillers per m$^2$ and seeds per ear obtained under D 134 (62.4 and 35.5) and Lok 1 (56.8 and 27.7) were remarkably higher than that of Kalyanasona (40.8 and 31.7), C 306 (51.7 and 27.2), Sonalika (48.4 and 24.2) and WH 147 (51.0 and 28.7) on silty clay loam soil during winter seasons of 1989-90 to 1991-92 at farmers field, Arjia, Bhilwara, Rajasthan.

Pandey *et al.* (1999) reported that UP-262 wheat variety recorded significantly more effective tillers/m$^2$ (346.65) on clay loam soil during winter season of 1993-94 and 1994-95 at research farm of Rajendra Agricultural University, Pusa, Bihar.

The wheat variety HUW-206 recorded higher spike length (13.58 cm), but was on par with UP-262 (13.13 cm) and both of them were significantly superior to K-8804 (11.76cm) on clay loam soil during winter season of 1993-94 and 1994-95 at research farm of Rajendra Agricultural University, Pusa, Bihar (Pandey *et al*. 1999).

The variety OW 6 recorded maximum no. of ears/m$^2$ (294 and 396) and grains/ear (30.2 and 32.4) respectively during 1998-99 and 1999-2000 at Regional Research and Technology Transfer Station, Bhawanipatna, Kalahandi, Orissa (Bastia D K and Rout A K 2001).

### 1000-grain weight (g)

Bastia D K and Rout A K (2001) reported that during 1998-99, 'UP262' recorded naximum1000-seed weight (40.7 g) where as during 1999-2000 'OW 6'recorded the maximum 1000-seed weight (43.2 g) on shallow black soil at Regional Research and Technology Transfer Station, Bhawanipatna, Kalahandi, Orissa

Shahzad Ali Bannori *et al.* (2005) reported that maximum 1000-grain weight was recorded by Tatara-96 (43 g), while the lowest (35 g) was produced by Fakhr-e-Sarhad during 1998-99 at Malkandher Research Farm, NWFP Agricultural University, Peshawar (Pakistan).

The wheat cultivar PBW-343 recorded the highest 1000-grain weight (41.01 g) while cultivar HD-2329 recorded the lowest 1000-grain weight (31.83 g) on sandy loam soil during winter season of 2003-04 at Research Farm of Ch. Charan Singh Shiv Dan Singh (P.G) College, Iglas, Aligarh, Uttar Pradesh (Yogesh Kumar Singh *et al.* 2007).

### Grain and straw yield

Singh *et al.* (1997) reported that among varieties HUM-234 gave the highest grain yield (19.7 and 19.0 q ha$^{-1}$) and Sonalika gave the lowest in yield (17.2 and 14.6 q ha$^{-1}$) during 1990-91 and 1991-92 at Kanpur.

Amongst the varieties GW 173 gave significantly higher grain yield (2918 kg ha$^{-1}$) than Swati (2574 kg ha$^{-1}$) and Mangla (2509 kg ha$^{-1}$) on sandy loam soil during *rabi* season of 1994-95 and 1995-96 at RARS, Indira Gandhi Krishi Viswavidyalaya, Raigarh, Madhya Pradesh(Patel *et al*. 1999).

Kanchan Nainwal (2000) reported that Raj-3077 variety recorded highest grain yield (3.98 t $ha^{-1}$) and was on par with UP-2338 (3.93 t $ha^{-1}$) and PBW-226 (3.69 t $ha^{-1}$) on silty loam soil during the *rabi* season of 1995-96 and 1996-97 at Crop Research Centre of GBPAUAT, Pantnagar.

Virender Sardana (2000) reported that in 1996-97, PDW 251 gave significantly higher yield (32.4 q $ha^{-1}$) where as in 1997-98 higher grain yield was registered with PDW 245 (30.6 q $ha^{-1}$) which was on a par with PDW 251(28.7 q $ha^{-1}$). Maximum straw yield was obtained with Raj 6516 and WH 912 and the minimum with WH 913 and PDW 251 during 1996-97 and 1997-98 respectively on loamy sand soil at Regional Research Station, Gurdaspur, Punjab.

Yogesh Kumar Singh (2007) reported that straw yield was not significantly affected due to varieties while cultivar PBW-343 recorded the highest (75.61 q $ha^{-1}$) straw yield on sandy loam soil during 2003-04 at Research Farm of Ch. Charan Singh Shiv Dan Singh (P.G) College, Iglas, Aligarh, Uttar Pradesh.

Purushotam Singh *et al.* (2010) reported that 'Shalimar wheat 1' recorded highest grain yield (4.48 t $ha^{-1}$) which is 10.8%, 13.7% and 5.77% more over 'VL 738', 'HS 240' and 'HS 365' varieties on silty clay loam soil during winter season of 2005-06 at RRS and FOA, Wadura of Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir.

### Harvest index

Purushotam Singh *et al.* (2010) reported that Shalimar wheat 1 recorded higher harvest index (37.07) on silty clay loam soil during winter season of 2005-06 at RRS and FOA, Wadura of Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir.

## POST HARVEST OBSERVATIONS

### Total (grain and straw) nitrogen uptake by crop at harvest

Patel *et al.* (1999) reported that among the varieties GW 173 and Lok 1 showed significantly higher nitrogen uptake (80.38 kg $ha^{-1}$ and 73.01 kg $ha^{-1}$) than Swati (67.64 kg $ha^{-1}$) and Mangla (70.97 kg $ha^{-1}$) on sandy loam soil during *rabi* season of 1994-95 and 1995-96 at RARS, Indira Gandhi Krishi Viswavidyalaya, Raigarh, Madhya Pradesh.

Parihar and Tiwari (2003) reported that the total uptake of the nutrients was higher in SL 788-2 (74.36 kg $ha^{-1}$) followed by DL 803-3 (67.11 kg $ha^{-1}$) due to significantly higher biomass on clay loam soils of Bilaspur, Chattisgarh during the *rabi* season of 1996-97 to 1998-99.

Pandey *et al.* (2008) reported that 'HP 1746' recorded the maximum nitrogen uptake (68.5 kg $ha^{-1}$) and UP 262 recorded the lowest nitrogen uptake (59.2 kg $ha^{-1}$) on clay loam soil at Research farm of Rajendra Aagricultural University, Pusa, Bihar.

### Agronomic efficiency, Physiological efficiency and Apparent Recovery Fraction

Purushotam Singh *et al.* (2010) reported that nitrogen use efficiency indices (agronomic efficiency 17.6 kg $kg^{-1}$, physiological efficiency 57.41 kg $kg^{-1}$ at 100 kg N $ha^{-1}$) showed superiority of 'Shalimar wheat 1' variety on silty clay loam soil during winter season of 2005-06 at RRS and FOA, Wadura of Sher-e-Kashmir University of Agricultural Sciences and Technology, Kashmir.

## ECONOMICS

Gupta *et al.* (1998) reported that higher gross and net returns of Rs 5899 and Rs 3922 were recorded by D-134 followed by Lok-10 on silty clay loam soil during winter season of 1989-90 to 1991-92 at farmer's field, Arjia, Bhilwara, Rajasthan.

Dilip Kumar Bastia and Ajay Kumar Rout (2001) reported that the cost-benefit ratio was obtained from 'OW 6' with 6 irrigations and 80-40-20 kg NPK $ha^{-1}$ on shallow black soil during the winter season of 1998-99 and 1999-2000 at Regional Research and Technology Transfer Station, Bhawanipatna, Kalahandi, Orissa.

Variety 'HP-1744' recorded significantly higher net returns (Rs12822) and cost-benefit ratio (1.9) than 'UP-262' (Rs 9635 and 0.89) on clay loam soil at Research farm of Rajendra Agricultural University, Pusa, Bihar (Pandey *et al.* 2008).

### Effect of Nitrogen Levels on Performance of Wheat Varieties

### Growth parameters

### Plant height (cm)

Shahzad Ali Bannori *et al.*(2005) reported that maximum plant height (114 cm) was obtained in plots fertilized with 150 kg N $ha^{-1}$, while it was minimum (100 cm) in control (0 kg $ha^{-1}$) during 1998-99 at Malkandher Research Farm, NWPF Agricultural University, Peshawar (Pakistan).

Goswami (2007) reported that there was progressive increase in the plant height of the wheat from control (66.72) to 100 kg $ha^{-1}$ (87.02 cm) during winter season of 2003 on sandy loam soil at the Research Farm of the A.S. College, Lakhaoti, Bulandshahr, Uttar Pradesh

Pandey *et al.* (2008) reported that plant height increased with increasing nitrogen only up to 80 kg $ha^{-1}$ (91.9 cm) , further increase in N level failed to produce significant effect on plant height on clay loam soil at Research farm of Rajendra Agricultural University, Pusa, Bihar.

**Leaf area index**

Ejaz Ahmed Warraich *et al.* (2002) reported that leaf area index was maximum (7.45) at 180 kg N $ha^{-1}$ and minimum (2.76) at 0 kg N $ha^{-1}$ at Student's farm, Department of agronomy, University of Agriculture, Faisalabad, Pakistan.

Mosalem *et al.* (2000) reported that increasing the nitrogen rate over 50 kg $ac^{-1}$ resulted in significant increasing leaf area index maximum (6.04)at 110 kg $ac^{-1}$ .and minimum at 50 kg $ac^{-1}$ during 1997-98 at Gemmeiza Agricultural Research Station, Egypt.

**Dry matter accumulation**

Satish Kumar *et al.* (1998) reported that the dry matter accumulation in leaf, stem, ear and shoot increased with increase in nitrogen application from 0 kg N $ha^{-1}$ (138.69 g $m^{-2}$) to 120 kg N $ha^{-1}$ (210.43 g $m^{-2}$) on sandy loam soil during *rabi* season of 1994-95 at Regional Station, Rohtak, Haryana.

Anil Kumar *et al.* (2001) reported that dry matter accumulation increased significantly up to 120 kg N $ha^{-1}$ (186 g per metre row length) over 80 kg N $ha^{-1}$ (170 g per metre row length) on loam sand soil at Bawl, Haryana during 1997-98 and 1998-99.

There was progressive increase in the dry matter of the wheat from control (21.92 g/plant) to 100 kg $ha^{-1}$ (25.24 g/plant) during winter season of 2003 on sandy loam soil at Research Farm of the A.S. College, Lakhoti, Bulandshahr, Uttar Pradesh (Goswami, 2007).

**Yield attributing parameters (Number of tillers per metre row length, ears/$m^2$, grains/ear and length of ear).**

Debey *et al.* (1989) revealed that increasing nitrogen doses improved grain yield and yield attributes of wheat like tillers/plant, ear length and grains/ear. Response of the grain yield was up to 60 kg N $ha^{-1}$in 1984-85 and up to 80 kg N $ha^{-1}$in 1985-86 during *rabi* season on clay loam soil at JNKVV, Tribal Agricultural Research Station, Dindori, Madhya Pradesh.

Azad *et al.* (1998) reported that fertilizer level up to 80 kg N $ha^{-1}$ increased significantly the effective tillers/m row length (123.37), ear length (8.84 cm), grains/ear (35.64) and 1000-grain weight (29.02 g) of wheat compared to control i.e, 0 kg N $ha^{-1}$ (86.31, 8.07, 30.40 and 27.59) at the experimental farm, R.S. Pura, Jammu during *rabi* season of 1994-95.

Higher dose of nitrogen (120 kg $ha^{-1}$) significantly increased the duration of crop, resulting in better growth and improvement in number of spikes per metre row length (50.6) and grains per spike (41.9) compared to lower levels of nitrogen (80 kg $ha^{-1}$) during 1996-97 and 1997-98 respectively on loamy sand soil at Regional Research Station, Gurdaspur, Punjab (Virender Sardana 2000).

Ajit S. Nehra *et al.* (2001) reported that application of increasing levels of nitrogen through fertilizer up to 120 kg $ha^{-1}$ improved the effective tiller number (107.6 per metre row length), grains/ear (49.13) over control during 1998-99 on sandy loam soil of Hisar, Haryana.

Saren and Jana (2001) reported that 100 kg $ha^{-1}$ nitrogen resulted in significant increase in all the yield attributes. Maximum tillers/$m^{-2}$ (341.1 and 347.5), grains/panicle (47.6 and 41.8) and 1000-grain weight (46.84 and 45.72 g) were observed during *rabi* season, 1992-93 and 1993-94 on sandy loam soil of Kalyani, West Bengal.

Anil Kumar *et al.* (2001) reported that application of N @160 kg $ha^{-1}$ recorded significantly more ears per metre row length (111.5 and 114.3) during 1997-98 and 1998-99 respectively on loamy sand soil at Bawl, Haryana,

Number of tillers per $m^2$ (618) increased significantly with increase in nitrogen level up to 180 kg $ha^{-1}$ at Students' farm, Department of Agronomy, University of Agriculture, Faisalabad, Pakistan (Ejaz Ahmed Warraich *et al.*2002).

Liaqat Ali *et al.* (2003) reported that application of N @150 kg $ha^{-1}$ resulted in maximum (408.0 and 416.0) number of tillers/$m^2$ during *rabi* 2000-01 and 2001-02 respectively on loam soil at Adaptive Research Farm, Vehari, Pakistan.

Increase in nitrogen application from 0 to 100 kg N $ha^{-1}$ significantly and progressively increased the number of effective tillers per metre row length (73 and 92.5), length of ear (9.7 and 11.2 cm) and grains per ear (34.4 and 39.8) during winter season of 1999-2000 on sandy loam soil at the Water Technology Centre, I.A.R.I, New Delhi (Kibe and Subedar Singh 2003).

Shahzad Ali Bannori *et al.* (2005) reported that maximum number of tillers/$m^2$ (363) was recorded when treated with 210 kg N $ha^{-1}$, while minimum number of tillers were observed (242) in control (0 kg $ha^{-1}$), during 1998-99 at Malkandher Research Farm, NWFP Agricultural University, Peshawar, Pakistan.

Progressive increase in number of tillers per plant was affected significantly by application of 100kg N $ha^{-1}$ (5.44) and was superior to control (0 kg $ha^{-1}$) (3.05) during winter season of 2003 on sandy loam soil at the Research Farm of A.S. College, Lakhaoti, Bulandshahr, Uttar Pradesh (Goswami, 2007).

Singh *et al.* (2007) reported that increasing the level of nitrogen up to 150 kg $ha^{-1}$ increased significantly the number of tiller/$m^2$ (324.9), length of spike(11.7) and number of grains per spike (39.5) compared to control (191.7, 7.1 and 31.1) during winter season of 2000-01 on sandy loam soil at Bichpuri, Agra.

## 1000-grain weight

Anil Kumar *et al.* (2001) reported that there was significant increase in test weight up to 120 kg N $ha^{-1}$ (42.50 and 46.50) on loamy sand soil at Bawl, Haryana, during 1997-98 and 1998-99 respectively.

Ejaz Ahmed Warraich *et al.* (2002) reported that grain weight increased with increase in nitrogen levels. Maximum 1000- grain weight (49.50g) was recorded at nitrogen level of 180 kg $ha^{-1}$ at Students farm, Department Agronomy, University of Agriculture, Faisalabad, Pakistan.

Liaqat Ali *et al.* (2003) reported that application of N @150 kg $ha^{-1}$ resulted in the highest 1000-grain weights of 41.2g and 42.4g during *rabi* 2000-01 and 2001-02respectively on loamy soil at Adaptive Research Farm, Vehari, Pakistan.

## Grain and Straw yield

Anil Kumar (1985) reported that increasing levels of nitrogen up to 120 kg $ha^{-1}$ increased the grain and straw yield of wheat significantly on loamy sand soil at Bawl, Haryana during 1997-98.

Bhagwan Singh *et al.* (1989) reported that increasing levels of nitrogen up to 160 kg $ha^{-1}$ resulted in significant increase in grain yield. The response to nitrogen was significant to up to 120 kg $ha^{-1}$ during 1986-87 and significant up to 160kg $ha^{-1}$ during 1987-88.

Singh (1997) reported that by increasing the level of N there was an increase in the grain yield significantly. The average of three years showed maximum grain yield (1244 kg $ha^{-1}$) at 80 kg N $ha^{-1}$ where as the minimum (1062 kg ha-1) at 40kg N $ha^{-1}$on sandy loam soil during *rabi* season of 1986-87 at Majhera, Nainital, Uttar Pradesh..

Binod Kumar and Roy P. Sharma (2000) observed that application of 120 kg N $ha^{-1}$ recorded significantly higher grain yield of wheat (38.84 q $ha^{-1}$). Percentage increase in productivity of wheat with 40, 80 and 120 kg N $ha^{-1}$ was 50.35, 79.46 and 95.57 percent respectively over control (0 kg N $ha^{-1}$).

Virender Sardana (2000) reported that application of 120 kg N $ha^{-1}$ significantly increased the grain yield of wheat (30.6 q $ha^{-1}$) over 80 kg N ha-1 (23.1 q $ha^{-1}$) during 1996-97 on loamy sand soil at Regional Research Station, Gurdaspur, Punjab.

Application of nitrogen @ 160 kg $ha^{-1}$ significantly increased grain (59.06 q $ha^{-1}$) and straw yields (85.09 q $ha^{-1}$) over lower 80 kg N $ha^{-1}$ (42.04 and 74.31 q $ha^{-1}$) during 1997-98 on loamy sand soil at Bawl, Haryana (Anil Kumar *et al.* 2001).

Nitrogen application increased the grain yield (29.19 and 35.33 q $ha^{-1}$) with successive increase in its level (80, and 160 kg $ha^{-1}$) on sandy clay loam soil during winter season of 1987-88 at College of Agriculture farm, Rajendranagar, Hyderabad (Srinivas 2002).

There was significant increase in grain (37.19 q $ha^{-1}$) and straw yields (43.42 q $ha^{-1}$) with 100 kg N $ha^{-1}$ compared to 0 kg N $ha^{-1}$ (18.60 and 22.61 q $ha^{-1}$) on sandy loam soil of A.S College, Lakhaoti, Bulandshahr, Uttar Pradesh (Goswami 2007).

Yogesh Kumar Singh et al. (2007) reported that there was significant increase in grain and straw yields (51.52 q $ha^{-1}$and 80.61 q $ha^{-1}$) at 160 kg N $ha^{-1}$ compared to 0 kg N $ha^{-1}$ (54.24 q $ha^{-1}$and 69.34 q $ha^{-1}$) during *rabi* season of 2003-04 at Agricultural Research Farm of Ch. Charan Singh, Shiv Dan Singh (P.G) College Iglas, Aligarh, Uttar Pradesh.

## Harvest Index:

Ved Singh *et al.* (2003) reported that increase in N levels increased harvest index steadily with maximum values of 38.3% 120 kg N $ha^{-1}$ in 1998-99 and 38.5% with 150 kg N $ha^{-1}$ in 1999-2000 during *rabi* season of 1999-2000 at Agricultural Research Station, Rajasthan Agricultural University, Sriganga nagar, Rajasthan.

The harvest index of wheat was maximum (38.4) with 100kg N $ha^{-1}$ and minimum (34.5) with 0 kg N $ha^{-1}$ on sandy soil during winter season of 1999-2000 at IARI, New Delhi (Kibe and Subedar Singh, 2003).

**Post-harvest observations:**

**Protein Content:**

Anil Kumar *et al.* (2001) reported that protein content significantly increased by 160 kg N $ha^{-1}$ (13.82%) over 80kg N $ha^{-1}$ (10.60%) during 1998-99 on loamy sand soil at Bawal, Haryana

Pandey *et al.* (2008) reported that application of 80 and 120 kg N $ha^{-1}$ recorded significantly higher protein content in grain (11.80% and 11.85% respectively) than control (11.62%) on clay loam soil during *rabi* season of 2000-01 at research farm of Rajendra Agricultural University, Pusa, Bihar.

**Agronomic Efficiency**, **Physiological Efficiency, Apparent Recovery Fraction:**

Ravindra Singh and Agarwal (2004) reported that agronomic efficiency reduced from 25.5 at 60 kg N $ha^{-1}$ to 14.3 kg grain added/kg N at 180 kg N $ha^{-1}$ application, highest physiological efficiency of 41.1 kg grain/kg N, 213.9 kg grain/kg P and 39.9 kg grain/kg K was recorded at 60 kg N $ha^{-1}$ application and Apparent recovery of N was reduced from 59.2% at 60 kg N $ha^{-1}$ to 32.6% at 180 kg N $ha^{-1}$ application during the winter season of 1997-98 on sandy loam soil of Hisar, Haryana.

**Nutrient uptake:**

**N, P, K status of soil at harvest**

Auti (1999) reported that final N P K status of the soil was maximum (154.69, 23.42 and 460.21 kg $ha^{-1}$) with 120:60:60 of N: $P_2O_5$:$K_2O$ kg $ha^{-1}$ and minimum (138.22, 17.39 and 427.52 kg $ha^{-1}$) with 30:15:15 of N: $P_2O_5$:$K_2O$ kg $ha^{-1}$ during 1994-95 on clay soil at Central Campus farm of MPKV, Rahuri.

**Total (Grain and Straw) uptake of Nitrogen:**

Ravindra Singh and Agarwal (2004) reported that the total uptake nitrogen was maximum (78.6 kg $ha^{-1}$) with 180kg N $ha^{-1}$ and minimum (24.3 kg $ha^{-1}$) with control (0 kg N $ha^{-1}$) during the winter season of 1997-98 on sandy loam soil of Hisar, Haryana.

Dileep Kachroo and Ravinder Razdan (2006) reported that maximum N uptake was highest (103.7 kg $ha^{-1}$) with 120 kg N $ha^{-1}$ and minimum (73.6 kg $ha^{-1}$) with 0 kg N $ha^{-1}$ during winter season of 2000-01 on clay loam soil of research farm, Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir

The total nitrogen uptake was maximum (197.74 kg $ha^{-1}$) with 160 kg N $ha^{-1}$ and minimum (65.29kg $ha^{-1}$) with 0 kg N $ha^{-1}$ on sandy loam soil during *rabi* season of 2003-04 at Agricultural Research Farm of Ch. Charan Singh, Shiv Dan Singh (P.G) College Iglas, Aligarh (Yogesh Kumar Singh *et al.* 2007)

Pandey *et al.* (2008) reported that the uptake of nitrogen by crop increased significantly with successive increase in nitrogen level. The highest level of nitrogen uptake (81.3 kg $ha^{-1}$) recorded with 120 kg N $ha^{-1}$ which was significantly higher than 0 kg N $ha^{-1}$ (33.0 kg $ha^{-1}$) on clay loam soil during *rabi* season of 2000-01 at research farm of Rajendra Agricultural University, Pusa.

**ECONOMICS**

Azad *et al*., (1998) reported that among the fertilizer levels maximum net profit of Rs 9975.29 obtained with higher fertilizer level of 80 kg N $ha^{-1}$ and minimum (Rs. 4965.50) with 0 kg N $ha^{-1}$ whereas cost-benefit ratio was also higher (2.59) with 80 kg N $ha^{-1}$ and lower (2.13) with 0 kg N $ha^{-1}$ during *rabi* season of 1995-96 at the experimental farm, R.S Pura, Jammu.

Ved Singh *et al*., (2003) reported that among the N levels, there was steady increase in net returns with increase in N level from 90 kg $ha^{-1}$ to 150 kg $ha^{-1}$. There was, however, a marginal reduction in net returns (Rs 258 and Rs 212) at highest level of 180 kg N over 150 kg N and cost-benefit ratio also followed the similar trend with highest value of 2.3 and 2.0 at N level of 150 kg $ha^{-1}$.

Ravindra Singh and Agarwal (2004) reported that the benefit-cost ratio was increased from 1.21 in no nitrogen to 2.13 in 180 kg N $ha^{-1}$. Application of 180 kg N $ha^{-1}$ recorded the maximum net returns of Rs 12,519 and minimum net returns of Rs 1984 with no nitrogen on sandy loam soil of Hisar, Haryana.

Pandey *et al.* (2008) reported that net returns increased significantly with increasing nitrogen levels and recorded maximum value (Rs 16372) at 120 kg N $ha^{-1}$. However, cost-benefit ratio (1.31) increased significantly only up to 80 kg N $ha^{-1}$, further increase in nitrogen level failed to produce significant effect on benefit cost ratio during *rabi* season of 2001-02 on clay loam soil of Research farm, Rajendra Agricultural University, Pusa, Bihar.

## REFERENCES


Ajit S. Nehra, Hooda, I.S and Singh, K.P. (2001). Effect of integrated nutrient management on growth and yield of wheat (*Triticum aestivum*). Indian Journal of Agronomy 46 (1): 112-117.

Anil Kumar (1985). Response of wheat cultivars to nitrogen fertilization under late sown condition. Indian journal of agronomy: 30(4): 464-467.

Anil Kumar, Bikram Singh and Jagdev Singh (2001). Response of macaroni wheat (*Triticum durum*) to nitrogen, phosphorus and sodic water on loamy-sand soils of south-west Haryana. Indian Journal of Agronomy 46(1): 118-121.

Auti, A.K., Wadile, S.C and Pawar, V.S. (1999). Yield, quality and nutrient removal of wheat (*Triticum aestivum*) as influenced by levels and sources of fertilizer. Indian Journal of Agronomy 44 (1): 119-122.

Azad, B.S., Bhagat, B.D., Bali, S.V., Dileep Kachroo and Gupta S.C. (1998). Response of late-sown wheat (*Triticum aestivum*) to seed rate and fertilizer level. Indian Journal of Agronomy 43(4): 653-656.

Bastia, D.K and Rout, A.K. (2001). Response of Wheat (*Triticum aestivum*) cultivars to fertilizers and limited irrigation. Indian journal of Agronomy.46 (4):670-673.

Behera, U.K and Pradhan, S. (2007). Performance of very late sown bread wheat cultivation as influenced by different level of nitrogen in the vertisols of central India. Annals if Agriculture Research.20 (2):127-131.

Bhagwan Singh and Gajendra Singh (1989). Effect of nitrogen on wheat cultivars under late sown condition. Indian journal of agronomy: 34(3): 387-389.

Binod Kumar and Roy Sharma, R.P. (2000). Effect of preceding crops and nitrogen rates on growth, yield and yield attributes of wheat. Indian Journal of Agricultural Research 34(1): 34-38.

Debey, O.P., Jain, M.P and Dubey, B.P. (1989). Response of tall Wheat cultivars to nitrogen Fertilization. Indian Journal of Agronomy .34(2):241-243.

Dileep Kachroo and Ravinder Razdan (2006). Growth, nutrient uptake and yield of wheat (*Triticum aestivum*) as influenced by biofertilizers and nitrogen. Indian Journal of Agronomy 51(1): 37-39.

Ejaz Ahmad, Warraich Nazir Ahmed, Shahzad, Basra, M.A and Irfan Afzal (2002). Effect of nitrogen on Source-Sink Relationship in Wheat. International Journal of Agriculture and Biology. 04-2-300-302.

Gupta, I.N., Maliwal, P.L. Anil Kothari and Rathore, S.S. (1998). Effect of variety and phenyl mercuric acetate on yield and economics of wheat (*Triticum aestivum*) under receding soil –moisture condition. Indian Journal of Agronomy 43(1): 87-89

.Goswami, V.K. (2007). Response of Wheat (*Triticum aestivum*) to nitrogen and Zinc application. Annals of Agricultural Research.28 (1):90-91.

Jaiswal, V.P and Singh, G.R. (2001). Effect of planting methods, source and level of nitrogen on growth and yield of rice (*Oryza sativa*) and on succeeding wheat (*Triticum aestivum*). Indian Journal of Agronomy 46(1): 5-11

Jat, L.N and Singhi, S.M. (2004). Growth, yield attributes and yields of wheat *(Triticum aestivum*) under different planting pattern or cropping systems and varieties. Indian Journal of Agronomy 49(2): 111-113.

Kanchan Nainwal and Mahendra Singh (2000). Varietal behaviour of wheat (*Triticum aestivum*) to dates of sowing under Tarai region of Uttar Pradesh. Indian Journal of Agronomy 45(1): 107-113.

Kibe, A.M and Subedar Singh (2003). Influence of Irrigation, nitrogen and Zinc on productivity and water use by late –sown Wheat (*Triticum aestivum* L.*)*. Indian journal of Agronomy 48(3):186-191.

Liaquat Ali, Qamar Mohy-Ud-Din and Musthaq Ali (2003). Effect of Different Doses of Nitrogen Fertilizer on the Yield of Wheat. International Journal of Agriculture and Biology 05-4-438-439.

Mosalem, M.E., Zahran, M., El Menoufi, M.M and Moussa, A.M. (2000). Effect of nitrogen fertilization levels on some wheat cultivars. Soil Fertility and Plant Nutrition.

Muhammad Aslam Khan, Muhammad Abid, Nazim Hussain and Tahir Imran (2005). Growth Analysis of Wheat (*Triticum aestivum* L.) Cultivars under Saline Conditions. International Journal of Agriculture and Biology 07-3-508-510.

Pandey, I.B, Thakur, S.S and Singh, S.K. (1999). Response of timely-sown wheat (*Triticum aestivum*) varieties to seed rate and fertility level. Indian journal of Agronomy.44 (4):745-749.

Pandey, I.B., Paswan, S., Singh, N.K and Pandey, R.K. (2008). Response of late-sown wheat (*Triticum aestivum*) varieties to nitrogen levels. Indian journal of Agricultural Sciences. 78 (6):537-539.

Panse, V. G and Sukhatme. (1978). *Statistical methods for agricultural workers 3rd edition*. Indian Council of Agricultural Research Publication, New Delhi p. 361.

Patel, S.R., Thakur, D.S and Nageshwar Lal (1999). Yield and nutrient uptake of wheat (*Triticum aestivum*) varieties under different sowing dates. Indian Journal of Agronomy 44(4): 733-737.

Parihar, S.S and Tiwari, R.B. (2003). Effect of irrigation and nitrogen levels on yield, nutrient uptake and water use of late-sown wheat (*Triticum aestivum*). Indian Journal of Agronomy 48(2): 103-107.

Piper, C. S. (1966). Soil and Plant Analysis. International Science Publishers Inc., New York. Pp-59

Purushotam Singh, Parmeet Singh, Singh, K N., Rekhi Singh, Aga, F. A., Bahar, F and Waseem Raja (2010). Evaluation of Wheat (*Triticum aestivum*) genotype for productivity and economics under graded levels of nitrogen in temperature Kashmir Indian journal of Agricultural Sciences. 80(5):380-384.

Ravindra Singh and Agarwal, S.K. (2004). Effect of organic manuring and nitrogen fertilization on productivity, nutrient-use efficiency and economics of wheat (*Triticum aestivum*). Indian Journal of Agronomy 49(1): 49-52.

Satish Kumar, Bangwara, A.S., Singh, D.P and Phogat, S.B. (1998). Dry matter accumulation in dwarf wheat varieties under different nitrogen levels and sowing dates. Haryana agricultural University Journal of Research. 28: 151-157.

Saren, B.K and Jana, P.K. (2001). Effect of depth of irrigation and level and time of nitrogen application on growth, yield and nutrient uptake by wheat (*Triticum aestivum*). Indian Journal of Agronomy 46 (2): 227-232.

Shahzad Ali Bannori, Shazma Anwar, Ahmad Din, Jehan Bakht and Muhammad Shafi (2005). Response of different wheat varieties to various nitrogen levels. Sarhad Journal of Agriculture. 21 (1): 5-10.

Sharma, P.K and Manohar, S.S. (2002). Response of wheat (*Triticum aestivum* L.) to nitrogen and sulphur and their residual effect on pearl millet (*Pennisetum glaucum* L.). Indian Journal of Agronomy .47(4):473-476.

Sharma, K.D and Ashok Kumar (2009). Physiological processes associated with grain yield of wheat under restricted soil moisture. Indian Journal of Plant Physiology 14(1): 55-59.

Singh, V.P.N., Singh, S.C and Uttam, S.K. (1997). Response of Wheat (*Triticum aestivum*) varieties to nitrogen under late –sown condition. Indian journal of Agronomy. 42(2):282-284

Singh, R.K., Agarwal, R.L and Sandip K. Singh (2007). Integrated nutrient management in wheat (*Triticum aestivum*). Annals of agricultural Research New series. 28(1):200-24.

Srinivas, A. (2002). Influence of nitrogen and methods of Zinc application on growth and Yield of Wheat (*Triticum aestivum*) varieties. Indian Journal of Agricultural Research.36 (3):167-171.

Subbiah, B. V and Asija, G. L. (1956). A rapid procedure for the determination of available nitrogen in soils. Current Science 25: 259-260.

Sushila, R and Gajendra Giri (2000). Influence of farm yard manure, nitrogen and biofertilizers on growth, yields attributes and yield of Wheat (*Triticum aestivum*) under limited water supply. Indian journal of Agronomy. 45(3):590-595.

Ved Singh, Bhunia, S.R and Chauhan, R.P.S. (2003). Response of late-sown wheat (*Triticum aestivum*) to row spacing-cum-plant densities and levels of nitrogen and irrigation in north-western Rajasthan. Indian Journal of Agronomy 48(3): 178-181.

Virender Sardana (2000). Effect of nitrogen application on grain yield and incidence of grain mottling of durum wheat (*Triticum durum*). Indian Journal of Agronomy 45(4): 711-716.

Yogesh Kumar Singh, Vikrant Singh and Jagvir Singh (2007). Response of various High Yielding Wheat varieties to different nitrogen levels in Aligrah region of Uttar Pradesh. Annals of Agricultural Research.20 (2):122-123.

ISSN : 0976-4550

# INTERNATIONAL JOURNAL OF APPLIED BIOLOGY AND PHARMACEUTICAL TECHNOLOGY

Email : ijabpt@gmail.com

Website: www.ijabpt.com