Chapter II
2. REVIEW OF LITERATURE

2.1 EFFECT OF NITROGEN:

Comprehensive review on the response of tall wheats to nitrogen under Indian conditions was presented by Yates et al. (1953). It was shown that wheat crop showed a positive response to nitrogen upto 45 kg N/ha. Though the magnitude of response varied from location to location.

After the introduction of dwarf wheats in the Country intensive research efforts have been made by the scientists to find out their nitrogen requirement. The effect of nitrogen on various characters of dwarf wheat is discussed below under different categories.

2.1.1 Growth and Growth Characters:

Ray (1965) found significant effect on height due to nitrogen application.

Aqarwal and Yadav (1978) reported that application of 80 and 120 kg N/ha significantly increased the plant height as compared to 40 kg N/ha during both the years of their study.

Kumar and Singh (1980) reported that application
of 80 kg N/ha gave significantly higher mean values for plant stand.

Bishnoi et al. (1983) reported that basal application of higher levels of nitrogen resulted in significantly lower number of seedlings during 1978-79, but the difference was not significant during 1977-78.

Singh and Agrawal (1983) observed that application of nitrogen promoted plant height.

Ghosh and Mukhopadhyay (1984) reported that increase in the level of nitrogen upto 40 kg N/ha could increase the plant height.

Chandrasekhararaih et al. (1985) reported from Dharwad that nitrogen at 150 kg/ha recorded significantly higher plant height compared to 50 kg N/ha. Plant heights due to 100 & 150 kg N/ha were at par.

Kumar (1985) also observed that height of wheat plant increased upto 180 kg N/ha.

2.1.2 Yield and yield attributes:

Agrawal (1971) reported from Kanpur that in trials in 1963-64 with 4 wheat cv sown in mid-Dec. at Varanasi, U.P., increases in the rates of applied N
from 0 to 123.5 kg/ha were accompanied by linear increases in average grain yield from 0.77 to 2.44 t/ha.

Gupta and Singh (1971) reported from wheat research station powerkheda that nitrogen application increased the number of grains per ear, length of the ear and grains yield but reduced the 1000-grain weight.

Agrawal et al (1972) observed from trials conducted at R.M.P.P. College, Narsan, Saharanpur, U.P. that the application of 100 kg N/ha gave higher increases in number of tillers/plant, ear length, number of grains per ear and grain weight/plant than did application of 60 or 140 kg N/ha.

Singh et al (1972) reported from UPAU Pantnagar that grain and straw yields of 'Kalyan Sona' wheat increased significantly up to 160 kg N/ha & upto 75 kg P₂O₅/ha during 1967-68 and 68-69. The grain yield could be described as a continuous function of nitrogen and phosphorus supply in the form of quadrate response surface function.

Singh and Anderson (1975) reported on the basis of experiments conducted at I A R I New Delhi in 1967-68
and 1968-69 that increased levels of nitrogen resulted in promoting yield attributes and grain yield. But the 1000 grain weight declined.

Daigre et al (1976) also reported from Nebraska that application of Nitrogen significantly increased wheat yield.

Hussain et al (1976) reported from Lyallpur that grain yield increased with increase in rate of applied N from 3200 lb/ac for the unfertilized control to 3392 lb/ac with 125 lb N/ac in 1972-73 and from 2064 to 2704 lb/ac in 1973-74 but differences in grain yield between the 75, 100 & 125 lb N/ac rates were non significant. The increase in yield over the control was attributable to increases in number of tillers/plant, length of ears, number of grains/ear and 1000 grain weight.

Singh and Sharma (1976) observed significant increase in length of ear upto 160 kg N/ha but 120 kg and 160 kg/ha were found at par during 1967-68. They also found that 1000 grain weight and yield increased significantly upto 120 kg N/ha. The grain weight and yield decreased at higher levels of nitrogen.

Sumbali and Gupta (1976) observed a significant
response to nitrogen up to 150 kg N/ha, beyond which the grain yield decreased.

Mohan et al. (1977) reported that number of ear/sqm. and the length of ear was significantly influenced by N application during both the years of their study. The maximum length of ear (8.4 and 8.7 cm in 1973 and 1974 respectively) was observed at 180 kg N/ha.

Pandey et al. (1977) reported from I.A.R.I., New Delhi that grain yield of wheat was significantly increased with application of nitrogen up to 180 kg N/ha. Application of nitrogen also increased significantly the water use efficiency.

Agrawal and Moolani (1978) reported that with increase in nitrogen application there was found a significant increase in grains and straw yields.

Agrawal and Yadava (1978) reported that application of 80 and 120 kg N/ha significantly increased the spikes/metre and grains per spike as compared to 40 kg N/ha during both the years of their study.

Patil and Khuspe (1978) reported that dwarf wheat variety H.D. 1953 showed significant and graded response up to 100 kg N/ha and 40 m.m. CTF irrigation. Increase in the level of Nitrogen increased biological
yield upto 100 kg N/ha.

Singh (1978) reported that ear length was not affected significantly by application of 60 kg and 120 kg nitrogen/ha.

Agarwal et al (1979) recommended, on the basis of field experiments conducted during 1975-76 and 1976-77 at Crop Research Farm Curswadi (Jhansi), that 120 kg N/ha gave significantly higher yield and net profit over 80 kg N/ha.

Singh et al (1979) conducted field experiments during 1975-76 and 1976-77 at B.H.U. Varansi to compare the effects of nitrogen levels, showing dates and methods of planting on yield of late sown wheat. It was found that grain yield increased significantly with the application of 100 kg N/ha whereas straw yield increased significantly upto 150 kg N/ha.

Borse and Mahajan (1980) studied at Mahatma Phule Krishi Vidyapeeth Rahuri the response of Sonalika wheat to depths of sowing, seed rates and nitrogen levels during 1970-71 and 1971-72. It was observed that application of nitrogen at 100 and 150 kg N/ha improved all the yield components as well as grain and straw yields over 50 kg N/ha.
Dayanand *et al* (1980) reported on the basis of field trials on cultivators field of the Union Territory of Delhi, that yield of grain increased significantly with increase in the level of nitrogen from 0 to 80 kg N/ha. However, no significant yield differences were observed when the nitrogen level was further increased to 120 kg N/ha. The yield increased significantly when the nitrogen level was increased to 160 kg N/ha.

*Kumar & Singh (1980)* reported/application of 80 kg N/ha gave significantly higher mean values for grain yield.

Reddy *et al* (1980) reported that nitrogen application increased total as well as grain producing tillers, ear length, spikelets and number of grains per ear, 1000 grain weight as well as grain and straw yields. Sonalika was found to have the highest 1000 grains weight.

*Malik (1981)* reported that grain yield increased with increasing levels of nitrogen upto 120 kg N/ha and, thereafter there was no increase in the grain yield. The nitrogen levels 80, 120 and 160 kg N/ha that were at par were found significantly better in yield over control.

*Vaishya and Singh (1981)* studied the effect of
seed rate, row spacing and nitrogen on yield & uptake of nitrogen in late sown wheat at C.S.A. University of Agriculture and technology, Kanpur during 1970-71 to 1972-73. They reported that 160 kg N/ha gave the highest straw yield in Sonalika variety.

Dhiman et al (1982) reported from H.A.U. Hissar that a significant increase in grain yield was observed upto 120 kg N/ha during 1978-79 and only upto 80 kg/ha during 1979-80. Significant increase in the effective tillers per metre, number of grains/spike and weight of grains was found with an increase in nitrogen levels.

Rana et al (1982) studied response of wheat to fertilizer application on cultivator's fields and concluded that application of 60 and 120 kg N/ha produced an increased yield of 8.72 and 13.72 q/ha over no nitrogen respectively.

Bishnoi et al (1983) reported that basal application of higher levels of nitrogen resulted in improvement in yield and yield attributes except 1000 grain weight.

Singh and Agarwal (1983) studied the effect of different levels of nitrogen and weed control methods
during 1976-77 and 1977-78 at R.M.P.P. College, Gurukul Narsan. They reported that application of nitrogen improved yield attributes viz. effective tillers, spike length and number of grains/spike. Straw and grain yields as well as nitrogen uptake was increased with the application of nitrogen.

Ghosh and Mukhopadhyay (1984) reported that increase in the level of nitrogen up to 40 kg N/ha could increase the number of ears/sq.m., number of grains/ear, test weight of wheat and grain yield.

Lal R.B. (1984) reported that grain productivity at 40 and 80 kg N/ha was identical in 1980-81 but postulated a reduction at 120 kg N/ha. Nitrogen at 80 kg/ha in 1981-82 and on pooled basis significantly enhanced grain yield over that at 40 kg N/ha. In this year also 120 kg N/ha showed a marginal decline in yield.

Nitrogen and variety interaction was also found to be significant.

Reddy & Bhardwaj (1984) on the basis of an experiment conducted at I.A.R.I. in 1978-79 & 79-80 reported that application of nitrogen increased grain and straw yields and all yield attributes except 1000 grain weight
which was decreased in both the years. Each increment of nitrogen increased the number of ears significantly upto 120 kg/ha, whereas the ear weight, fertility ratio of spikelets and number of grains/ear increased upto 80 kg/ha only. Successive increment of nitrogen upto 80 kg/ha increased the grain and straw yields in both the years but the difference between 80 kg and 120 kg N/ha was found to be significant in 1978-79 only.

Singh and Singh (1984) reported on the basis of an experiment conducted at A.S. College, Lakhaoti in 1982 that application of nitrogen did not influence the yield attributes except 1000-grains weight which was reduced significantly by increasing doses of nitrogen upto 160 kg/ha. The grain yield increased significantly with an increase in the level of nitrogen upto 120 kg/ha beyond which there was a significant decrease in the grain yield with increase in the level of nitrogen to 160 kg/ha (most probably due to lodging).

Chandrasekharaih et al (1985) reported from Dharwad that application of 150 kg N/ha resulted in 37 and 8% higher grain yield of wheat over 50 and 100 kg N/ha respectively. Similar trends were observed with regard to ear length due to various N-levels. The influence
of various N levels on 1000 grain weight was not significant.

Kalyan Singh et al (1985) on the basis of a field trial at R.A.K. College of Agriculture Sehore, reported that grain yield increased with increasing nitrogen levels. However, 1000 grain weight showed declining trend. The higher dose of 160 kg N/ha produced more number of grains and as such accounted for low test weight. These results are in accordance with the findings of Singh and Sharma (1976), Khan et al (1977), and Sandhu et al (1978). Straw yield also increased with increasing nitrogen levels.

Kapur et al (1985) also reported an increase in grain yield of wheat upto 120 kg N/ha.

Kumar (1985) reported that length of ear increased upto 180 kg N/ha. He further reported that number of grains/ear was not affected significantly by N levels.

2.1.3. Quality of Wheat:

Daigger et al (1976) reported from Nebraska that application of nitrogen significantly increased N-content of wheat.
Patil and Khuspe (1978) reported that protein content in wheat variety H.D. 1953 increased with increase in the level of nitrogen up to 100 kg N/ha.

Singh and Agarwal (1983) observed that nitrogen uptake was increased with the application of nitrogen.

2.1.4. **Optimum dose:**

Bhardwaj and Wright (1967) reported that under varied field conditions 100-120 kg N/ha gave a maximum return from dwarf wheats. Although there has been some variation in the optimum dose of nitrogen worked out by different research workers, which could be attributed to variation in soil fertility, soil moisture, agro-climatic conditions and cultural practices, yet the economic optimum dose under most situations has been reported to range between 100 to 240 kg N/ha (Sharma et al, 1971, Agarwal et al, 1972, Singh and Anderson, 1975, Patel and Khuspe, 1978).

Sharma et al (1971) observed at Pantnagar that application of 120 kg N/ha was optimum in timely as well as late sowings of wheat.

Singh and Anderson (1975) reported from I.A.R.I. (New Delhi) that nitrogen up to 100 kg/ha proved optimal
and at par with 150 kg/ha for increasing yield and its attributes.

Biswas and Singh (1982) recorded optimum dose of nitrogen to be 71.8, 93.1 and 105.8 kg N/ha for Jyoti, DL-70 and Arjun varieties respectively.

Singh and Agarwal (1983) reported that optimum dose of nitrogen ranged from 84 to 109 kg N/ha.

2.2. EFFECT OF IRRIGATION

The most practical approach for scheduling irrigation to wheat is the one based on physiological growth stages of wheat. There is concurrence of opinion that CRI stage (20-25 days after sowing) is the most critical stage for irrigation as it results in maximum production per unit of water applied (Bhardwaj and Wright 1967; Bhardwaj, 1973).

Mathur and Shekhawat (1971) observed at Regional Research Station, Borkhera, Kota, Rajasthan that average grain yields of 4 dwarf wheat cv. were higher with first irrigation applied at 22 and 29 days than on other dates in 1967.

Singh and Narang (1971) reported from P.A.U.
Ludhiana that yields of dwarf cv. Kalyan Sona and Sonalika were higher (4.92 and 3.47 t, respectively) with the first irrigation applied at 21 days after sowing than when applied on other dates i.e. at 14, 33, 38, 43 or 48 days after.

Singh et al. (1977) observed from B.H.U. Varanasi that first irrigation at crown root initiation and subsequent irrigation at 50% available moisture depletion was found to be associated with the maximum grain yield of wheat. It was further reported that delaying the first irrigation beyond crown root initiation stage hampered the growth and development and ultimately reduced the economic yield of the crop.

Delay in first irrigation or its application before the CRI stage gave lower yields.

Sharma and Bhardwaj (1983) reported that irrigation at crown root initiation (CRI) stage produced more tillers, fertile spikelets, number of grains/ear and grain and straw yields as compared to irrigation at later stage.

Sharma (1968-69) reported from U.P. Agri. University Pantnagar that Sonalika suffered most due to late irrigation followed by Kalyan Sona & Chhotilerma (S. 331) Sonalika variety when irrigated 21 days after sowing gave the highest
yield followed by 14 days after sowing and the yields of the two treatments were significantly higher than the yields from 42 and 49 days after sowing. In case of chhoti lerma (S. 331) variety irrigation 28 days after sowing gave highest yields which was significantly higher than the yield from 14 days after sowing.

Anonymous (1984-85) reported on the basis of experiments conducted at G.R. Pant University of Agriculture and Technology that for late sown wheat the first irrigation should be given 30 days after sowing.

Sharma et al. (1985) on the basis of an experiment conducted at Karnal during 1981-82 and 1982-83 reported that yield attributing characters, grain and straw yield were significantly higher when first irrigation was applied 27 or 30 days after sowing under low E.S.P. (28-33 at 0-15 cm. depth) and 30 or 33 days after sowing under higher E.S.P. (38-50 at 0-15 cm soil depth). The study further indicated that in sodic soil (28-50 ESP) first irrigation should be applied 30 days after sowing of wheat.

Bhardwaj et al. (1985) reported that in case of wheat sown after rice in heavier soil, the difference between first irrigation 20 and 40 days after sowing were
not significant.

Chowdhury and Singh (1986), Singh and Panwar (1987) and Sharma et al (1988) have recommended that first irrigation under late sown conditions of wheat should be given 28-30 days after sowing.

2.3. **SEED CONDITIONS**

In late sown wheat experiments have been conducted using dry, soaked and sprouted seeds at different places with varying results. The research work carried out by those workers comparing dry, soaked and sprouted seeds are described here under two heads

(A) **Dry vs Treated** (including soaked as well as sprouted)

(B) **Soaked vs Sprouted**

(A) **Dry vs Treated**:

Although Hafiz (1958) reported negative effects of pre-soaking in normal water or salt solution, yet the intensive work on soaking of Caryopsis was initiated in 1959 by Kydrev for increasing drought resistance capacity and germination rate and also to induce forced dormancy in the seed of wheat. Soaking of seed showed favourable results. Patil and Vashli (1961) worked on the growth
performance of different crops raised from sowing seed soaked in water and found early start of the crop and increase in absorption capacity of moisture as well as completing most of the growth phases earlier and recorded early maturity in different crops than dry seed. Dawson (1965) suggested the soaking of seed in water for saving the seedlings from low temperature injuries.

Bains et al (1968) and Bains (1968b), from I.A.R.I., New Delhi on the basis of coordinated field trials, recommended soaked seeds for getting early and better germination and higher grain yield under late sown conditions of wheat which was generally sown after the harvest of sugarcane, toria, potato, cauliflower and other vegetable crops in western U.P., Punjab, Haryana, Delhi and parts of Rajasthan.

Alexander and Mishra (1972) observed in the field trials conducted at B.H.U., Varanasi in 1968-70 that soaking of wheat seed in a 2.5% KCl solution before sowing increased grain yield by 21% in 1968-69 and 3% in 1969-70 in comparison with control.

Dayanand et al (1972) suggested soaking of seed for higher yield of late sown variety of wheat Sonalika. The yield increased by 15.26 by using soaked seed over
unsoaked seed. Soaking of seed also increased germination of crop.

Shukla and Singh (1972) recommended soaked seeds for higher grain yield of 44.25 q/ha as compared to 40.30 q/ha obtained from unsoaked seed.

Kononova (1973) reported from Leningrad USSR that treatment of seed of winter wheat with Granosan or thiram each at 1.5-2 g/kg seed, increased germination vigour and percentage, markedly decreased winter kill of plants and resulted in grain yields of 2.79-3.05 t/ha in 1969 and 2.1-2.72 t/ha in 1970 compared with 1.59 and 1.77 t/ha respectively for untreated seeds. Treatment with thiram applied several weeks before sowing, gave the highest yield.

Nosov and Chesnova (1973) reported from Tukmen that in trials with wheat in 1967-69, soaking seed in solutions containing 0.05% Mn or 0.1% B increased germination, stand density, and resulted in average grain yield of 2.54-2.61 t/ha compared with 2.14 t/ha for untreated seed; application of Cu & Zn was less effective.

Sikorskii and Nemchenko (1973) reported from USSR that in trials with spring wheat given 80 kg N + 60 kg P₂O₅ + 30 Kg K₂O/ha, seed treatment with 40% Tur (Chlormeguat)
solution at 10 l/1 seed decreased plant height by reducing length of the lower 3-4 internodes, prevented lodging, increased tillering and LAI and resulted in grain yield of 4.03 t/ha compared with 4.03 t/ha for untreated seed.

Sharma (1975) conducted experiments at Indore from 1969-70 to 1971-72 and reported a higher yield from soaked seed over dry ones under late sown conditions. The difference was however not significant.

Singh and Verma (1976) and Singh and Verma (1977), on the basis of their experiments conducted at C.S.A. University of Agriculture and Technology, Kanpur observed that soaking of seed in water for 12 to 14 hours increased the germination, number of tillers per plant, number of functional leaves per shoot, number of tillers per unit area and fresh & dry weight per shoot over dry seeds. Yield and yield attributing characters were also found to be higher in soaked seeds than dry seeds.

Kumar and Singh (1980) conducted a micro-plot experiment on wheat variety HD-2009 during 1976-77 and 1977-78 and reported that pre-soaking of seed for 4 hours in irrigation water did not show any appreciable impact on yield and its components. However, 8 hours of pre-soaking gave rather little positive but non-significant
response over the 0 hour and 4 hours presoaking treatment.

Mishra and Dwivedi (1980) conducting experiments in 1974-75 and 1975-76 on 12 varieties of wheat at B.H.U., Varanasi, reported that pre-sowing seed treatment with distilled water increased significantly the yield of straw and grain, plant height, number of tillers per plant, number of green leaves and dry matter per plant over dry seed.

Khan and Chatterjee (1981) conducted trials on late sown wheat in 1975-76 and 1976-77. They reported higher values of plant density, number of tillers per unit area, number of spikes per unit area, spike length and grain yield with soaked seeds as compared to dry ones in 1976-77. While in 1975-76, plant density and grain yield with soaked seeds were found significantly higher than with dry seeds. The grain yield was found to be 25.10 q/ha with soaked seeds as compared to 21.70 q/ha with dry seeds.

Mehrotra et al. (1981) reported significantly higher yield from sprouted seeds soaked in Ascorbic acid than that from dry seeds.

Sewa Ram and Bhardwaj (1983) conducted experiments at I.A.R.I., New Delhi during 1972-73 and 1973-74 to determine
the package of optimum agro-techniques for pushing up yields of late sown wheat. It was reported that soaking of seed in water offered no advantage whatsoever. Soaked seeds did not affect significantly the dry matter yield/plant, grain as well as straw yields and the number of grains/spike.

On the basis of the research work quoted above, the superiority of soaked seeds over dry seeds in general has been observed. These research workers have recorded early germination, protection of seedlings from low temperature injuries, early maturity, more number of tillers per plant as well as per unit area, more number of leaves/shoot, more fresh and dry weight/shoot and higher values for all yield attributing characters in soaked seeds as compared to dry seeds.

Mandal and Basu (1987) observed that mid term soaking-drying treatment of wheat seed, gave significantly higher grain yield/m² than control with and without fertilizer application.

(B) Soaked vs Sprouted:

Dhillan and Panwar (1971), reported on the basis of experiment conducted at Ludhiana that crop raised from
sprouted seed was not comparable to transplanting but was very much superior to that raised from unsprouted in regard to both germination and yield.

Singh and Verma (1976) and Singh and Verma (1977) reported from Kanpur that sprouting of seed as a super imposed practice over soaking had increased germination, number of shoots, important yield contributing character and the grain yield as compared to soaked seeds.

Tomer and Verma (1980) reported from Kanpur that sprouting of seed for 48 hours produced significantly more number of shoots per unit area at maximum tillering than soaked ones. Sprouting also increased numerically the height of main shoot, number of leaves per shoot, fresh and dry weights per shoot, average number of tillers per shoot, mortality of tillers as compared to soaked ones. Sprouting of seed increased significantly the length of ear, number of fertile spikelets per ear, number of grain per ear and 1000 kernel weight. The sprouted seed also produced significantly higher yield of grains and straw than soaked seeds. Sprouting of seed did not affect significantly the harvest index over soaked seeds.

On the basis of the above review Singh and Verma (1976), Singh and Verma (1977) and Tomer and Verma (1980)
reported superiority of sprouted seeds over soaked seeds.

The sprouted seed increased significantly the number of shoots per unit area, height of main shoot, number of leaves per shoot, fresh and dry weight per shoot, length of ear, number of fertile spikelets per ear, number of grains per ear and 1000 Kernel weight and also increased numerically the average number of tillers per shoot, ear weight, number of spikelets per ear and grain weight per ear as compared to soaked seeds. Grain and straw yields were also increased by using sprouted seed as compared to soaked ones.

2.4 VARIETIES

Dayanand et al (1977) reported from I.A.R.I., New Delhi that Sonalika variety is more efficient in nutrient uptake (NPK) as compared to other varieties.

Varma and Rathi (1978) conducted an experiment to compare varietal performance of late sown wheat and recommended Sonalika and K 816 varieties for late sowing upto Dec.30.

Agarwal et al (1979) recommended Sonalika variety to be superior to H.I.385.
Sehgal et al (1983) reported that variation in protein content due to varieties was significant. No inter-relationship was found between protein content and yield. The protein content ranged from 10.4 to 14.9%.

Lal R.B. (1984) reported that variety H.D. 2285 gave significantly higher yield than Sonalika during 1980-81 but the difference was not significant during 1981-82. It was further observed that number of grain/ear was significantly higher in H.D. 2285 as compared to Sonalika but 1000 grain weight was significantly higher in Sonalika as compared to HD 2285.

* *