e ISSN–2321–7987 | ●●● Article ●●● |Visit us : *www.researchjournal.co.in*|

Wheat crop ensuring food security in India

Arvind Kumar[1], **Sudhir Kumar[2],** Ashok Kumar[3] **and** O.V.S. Thenua[4]
[1]Indogulf Crop Sciences Ltd., New Delhi (India)
[2]S.S.I. College, Khatuli, Muzaffarnagar (U.P.) India
[3]ICAR- NASF, KAB-1, Pusa Campus, New Delhi (India)
[4]A.S. College, Lakhaoti, Bulandshahr (U.P.) India

Wheat is the second most important crop in India and a principal source of calorie intake. During independence, the country was dependent on wheat import to meet the food demand of the country. Due to the lodging prone low yielding nature of Indian wheat under high fertility conditions, there remained a continuous need for a breakthrough in wheat production. The dream of Dr. M.S. Swaminathan, the father of green revolution in India during mid sixties that came true to materialize the spurt of the Green Revolution in the India by which our country to meet domestic demand from its own production and became a wheat surplus country from a deficient one. Wheat crop plays a major role in creating a status of food security in India. The production level of Wheat in India had a quantum jump from 6.46 million tons from an area of 9.75 million ha in 1950-51 to more than 93.50 million tons from an area of about 302.27 million hectares with productivity of 3093 kg per hectare during 2015-16.

Agro-climatic zones of wheat in India: Wheat is a very adaptable crop and is grown under the wide range of soil and climatic conditions. The crop is most successfully grown between latitude of 30^0 N and 60^0 N and between 27^0 S and 40^0 S. In India it is grown mostly in the plains where as in the hills it is cultivated in mountainous region of North India and Nilgiris and Palani hills in South India. The entire wheat growing areas of the country has been categorized into six major zones as follows:

Classification of wheat: Currently, India is second largest producer of wheat in the world after China with about 12% share in total world wheat production. In India, only three species of wheat namely *Triticum aestivum* (Common bread wheat), *Trititicum durum* (Macroni or Durum wheat) and *Triticum dicoccum* (Emmer wheat) are economically important with 95, 4, and 1 per cent of the total wheat production of India, respectively. *T. aestivum* grown in whole of North India and also in Central and South India While, *T. durum* is grown in central and south India and *T. dicoccum* is grown only on limited acreage in Tamil Nadu, Andhra Pradesh, Maharashtra and Gujarat.

Climate: Wheat crop has wide adaptability and mainly a *Rabi* (winter) season crop in India. It can be grown not only in the tropical and sub-tropical zones but also in the temperate zone and the cold tracts of the far north, beyond

Table 1 : Entire what growing areas of the country categorized into six major zone

Sr. No.	Zones	States/regions covered	Acreage (%)
1.	Northern Hill Zone (NHZ)	Hilly areas of J&K (except Jammu, Kathua and Samba districts), Himachal Pradesh (except Una and Paonta valley), Uttarakhand (excluding Tarai region) and Sikkim	2.9
2.	North Western Plains Zone (NWPZ)	Punjab, Haryana, Western UP (except Jhansi Div), Rajasthan (excluding Kota and Udaipur div), Delhi, Tarai region of Uttarakhand, Una and Paonta valley of HP, Jammu, Samba and Kathua districts of J&K and Chandigarh	40.1
3.	North Eastern Plains Zone (NEPZ)	Eastern UP (28 districts), Bihar, Jharkhand, West Bengal, Assam, Odisha and other NE states (except Sikkim)	33.2
4.	Central Zone	MP, Gujarat, Chhattisgarh, Kota and Udaipur Div of Rajasthan and Jhansi Div of UP.	18.1
5.	Peninsular Zone	Maharashtra, Tamil Nadu (except Nilgiris and Palani Hills), Karnataka and Andhra Pradesh,	5.4
6.	Southern Hill Zone (SHZ)	Nilgiris and Palani Hills of Tamil Nadu	0.4

even the 60 degree north altitude. Wheat can tolerate severe cold and snow and resume growth with the setting in of warm weather in spring. It can be cultivated from sea level to as high as 3300 meters.

The ideal temperature requirement varies from plant type and stages of growth. The optimum temperature range of wheat for ideal germination is 20-25^{0}C, tillering is 16-20^{0}C, accelerated growth is 20-23^{0}C and proper grain filling is 23-25^{0}C. The temperature conditions at the time of grain filling and development are very crucial for yield. Temperatures above 25^{0}C during this period tend to depress grain weight. When temperatures are high, too much energy lost through the process of transpiration by the plants and the reduced residual energy results in poorer grain formation and lower yields.

Soil: Wheat is grown in a variety of soils of India. Clay loam or loam texture having good structure and moderate water holding capacity are ideal soil for wheat cultivation.

Improved varieties: At present, good choice of improved varieties is available to farmers for growing under different production conditions.

ZT technique for sowing of wheat: This new method is very useful in rice-wheat cropping system where showing of wheat is delayed due to multiple reasons, *viz.*,

Table 2 : Improved varieties

Zone	Production condition	Varieties
Northern Hills Zone (NHZ)	TS-IR-high fertility	HPW 349, HS 507, VL 907, VL 804, VL 738*
	TS-RF-low fertility	HPW 349, HS 507, VL 907, SKW 196*, VL 804, VL 738*, TL 2969 (trit), TL 2942 (trit)
	ES-RF-low fertility	HS 542, HPW 251, VL 829
	LS-RI-medium fertility	VL 892, HS 490, HS 420
	High altitude areas	VL 832, HS 375
North Western Plains Zone (NWPZ)	TS-IR-high fertility	DBW 88, HD 3086, WH 1105, HD 2967, DPW 621-50, PBW 550*, WHD 943(d), PDW 314 (d), PDW 291(d)
	LS-IR-medium fertility	DBW 90, WH 1124, DBW 71, HD 3059, PBW 590, WH 1021, DBW 16, WR 544 (VLS), RAJ 3765*
	TS-RF-low fertility/RI	PBW 644, WH 1080, HD 3043, PBW 396
North Eastern Plains Zone (NEPZ)	TS-IR-high fertility	NW 5054, K 1006, DBW 39, CBW 38, Raj 4120, K 307, HD 2824, HD 2733, PBW 443, HUW 468, NW 1012
	LS-IR-medium fertility	DBW 107, HD 3118, HD 2985, HI 1563, NW 2036, HW 2045, DBW 14, NW 1014, HD 2643
	TS-RF-low fertility	HD 2888, MACS 6145
Central Zone (CZ)	TS-IR-high fertility	MP 3288, HI 1544, GW 366, GW 322, GW 273, HI 8713 (d), MPO 1215 (d), HI 8498(d),
	LS-IR-medium fertility	MP 3336, Raj 4238, MP 1203, HD 2932, HD 2864, MP 4010
	TS-RF-low fertility/RI	DBW 110, MP 3288, MP 3173, HI 1531, HI 8627(d), HI 1500, HD 4672(d), HW 2004 (Amar)
Peninsular Zone (PZ)	TS-IR-high fertility	MACS 6478, UAS 304, MACS 6222, NIAW 917, Raj 4037, GW 322, HUW 510, UAS 428 (d), UAS 415 (d), MACS 2971(dic), HI 8663(d), DDK 1029 (dic), DDK 1025(dic)
	LS-IR-medium fertility	HD 3090, AKAW 4627, HD 2932, Raj 4083, PBW 533, HD 2833
	TS-RF-low fertility/RI	NIAW 1415, HD 2987, PBW 596, HD 2781, K 9644, AKDW 2997-16(d)
Southern Hills Zones (SHZ)	TS-RI-medium fertility	HW 5216, HW 2044, HW 1098 (dic), HW 1085, COW (W) -1
Marginal areas	Salinity-alkalinity condition	KRL 210, KRL 213, KRL 19

Source : ICAR

where, TS=Timely Sown, LS=Late Sown, VLS= Very late sown, ES=Early Sown, IR=Irrigated, RF=Rainfed, RI=Restricted irrigation, (d)=durum, dic.=dicoccum and trit=Triticale. *indicates stripe rust susceptibility and thus must be avoided in rust prone areas.

preparation of field, uncertain rainfall and rice harvesting with traditional method. Out of these, the field preparation is one of the most important reasons, which causes delay in wheat sowing. Puddling in transplanted rice creates a hard pan in the field. After harvesting of rice crop, field requires at least 6-8 tillage operations in ploughing and harrowing for sowing of wheat, in which generally 10-15 days are required for proper field preparation. Yield of wheat decreases approximate @ 30 kg/ha/day after 25 November sowing.

Sowing time, seed rate and fertilizer application: The wheat crop in India is grown across six agro-climatic zones and production conditions. The time of sowing has slight variation from zone to zone and under varying production conditions. Always use certified seed. If seed is not treated, treat with Vitavax or Bavistin @ 2.5 g/kg of seed.

Spacing: For irrigated timely sown wheat, a row spacing of 15 to 22.5 cm is followed, but 22.5 cm between the rows is considered to be the optimum spacing with 5-6 cm planting depth. Under irrigated late-sown conditions, a row spacing of 15-18 cm is the optimum.

Weed management: In a country like an India where agriculture predominates, weeds have a major role to play in the economy of the country. However, these plants not only affect the crop plants by competing with them for necessary requirements, but also act as alternate hosts

Table 3 : Zone-wise sowing time, seed rate and fertilizer dose for wheat crop

Zone	Sowing conditions	Seed rate	Fertilizer doses and time of application
NHZ	Irrigated timely sown (1-15 Nov.)	100 kg/ha	120:60:40 kg NPK /ha
	Irrigated late sown (After 25th Nov.)	125 kg/ha	90:60:40 kg NPK /ha
	Rainfed	125 kg/ha	60:30:20 kg NPK/ha to be applied at the time of sowing
NWPZ and NEPZ	Irrigated timely sown NWPZ: 1-15 Nov. NEPZ: 10-20 Nov	100 kg/ha	150:60:40 kg NPK /ha
	Irrigated late sown (After 25th Nov.)	125 kg/ha	120:60:40 kg NPK /ha
	Rainfed	125 kg/ha	60:30:20 kg NPK/ha to be applied at the time of sowing
CZ, PZ and SHZ	Irrigated timely sown CZ: 10-20 Nov PZ: 1-15 Nov SHZ: Mid Nov.	100 kg/ha	120:60:40 kg NPK /ha
	Irrigated late sown	125 kg/ha	90:60:40 kg NPK /ha
	Rainfed	125 kg/ha	60:30:20 kg NPK/ha to be applied at the time of sowing

*ROOT-O-MAX GOLD (10-15 kg/ha) & INDO MYCORRHIZA (10 kg/ha)

Table 4 : Options for weedicides to control different types of weeds

Weed flora	Herbicides	Product dose (g or ml/ha)	Time of application DAS
Grasses	Penda Shree (Pendimethalin 30% EC)	5000	Pre-emergence 1-3 DAS
	Weeder (Sulfosulfuron 75% WG)	33-35	Post emergence 30-35 DAS
	Jai Ho (Clodinafop-Propargyl 15% WP)	400	Post emergence 30-35 DAS
Broad-leaved weeds	Penda Shree (Pendimethalin 30% EC)	5000	Pre-emergence 1-3 DAS
	CUT OFF 38 (2,4-D-E 38% EC)	1250-2000	Post emergence 30-35 DAS
	Indogulf Alto (Mesosulfuron Methyl 20% WP)	20	Post emergence 30-35 DAS
Both grassy and broad-leaved weeds	Weeder (Sulfosulfuron 75% WG)	33-35	Post emergence 30-35 DAS
	Penda Shree (Pendimethalin 30% EC)	5000	Pre-emergence 1-3 DAS
	Penda Power (Pendimethalin 308.7% CS)	850-875	Pre-emergence 1-3 DAS

*Use Ankur Gold @ 5ml/15 ltr. spray solution for increasing effectiveness of the agro chemical.

for various fungal, bacterial and viral pathogens of crop plants. For effective control measures of these unwanted plants, knowledge of their floristic composition in different agro-ecosystems and their seasonal behaviour and phenology are essential. Based on weed flora following herbicides can be applied.

Some useful hints :

Do's

– Spray the herbicides, both pre and post emergence, when there is sufficient moisture in the soil.

– Spray the post-emergence herbicides when Phalaris minor is at 2-3 leaf stage.

– Spray on clear and sunny days only when the leaves are dries.

– Use only flat fan nozzle especially for Fenoxaprop.

– Remove Phalaris minor before seed setting and use as fodder.

– Ensure complete coverage of the field.

Don'ts

– Never apply these post emergence herbicides by mixing with sand, urea or soil.

– Grass herbicides (Clodinafop) should not be tank mixed with either 2,4-D or Metsulfuron and to avoid antagonism the grass and broad-leaved herbicides should be applied sequentially.

– Do not use Sulfosulfuran in mixed cropping system of wheat and mustard or other crops

Water management: The normal practice of applying four to six irrigations (28-42 cm-ha water) are enough for wheat crop. Depending upon the water availability, irrigation should be applied as per the scheduled.

Crop protection : The host resistance is the cheapest, effective and environmental friendly means management of disease and pests. The disease scenario of different zones varies but the problem of yellow rust disease which is prevalent in NHZ and SHZ, NWPZ and NEPZ of the country is a major cause of concern. Karnal bunt incidence increased during last years in NWPZ.

Rust management: In NWPZ and NHZ, stripe rust (yellow rust) is very important. Usually, it is observed that the early infection of stripe rust starts in wheat field's under the poplar trees wherever these are grown having early sown crop (*i.e.* October). Hence, strict watch is needed by the farmers in such fields. More over for avoiding the losses due to stripe rust of wheat in NWPZ, recommended varieties be sown.

Since most of the varieties recommended for NWPZ and NHZ do not carry high level of resistance, hence, chemical sprays are needed. Spray the crop with **Srizol** (Propiconazole 25% EC) @ 375-750 ml/ha, or Figon (Tebuconazole 25.9 % EC) 750-1000 ml/ha. Usually, it is required in the first half of February.

Stem and leaf rusts are the major diseases of wheat in CZ, PZ and SHZ. From rust epidemiology point of view, for disrupting the *Puccinia* path, rust resistant varieties should be grown in respective zone.

Loose smut: Loose smut is a seed borne disease. In view of the horizontal distribution of the seed material among the farmers and the use of the carry over seed effective control measures for lose smut should be undertaken. For this, seed treatment with Rexcel DS (Tebuconazole 2 % DS) @ 2.5g/kg seed is recommended.

Flag smut: Flag smut disease also poses problems in isolated fields in Punjab, Haryana, Rajasthan and some other parts of NWPZ. Disease management measures taken for the control of loose smut disease (as discussed above), prove to be effective against flag smut too.

Karnal bunt: Karnal bunt (KB) control is required for seed crop and the produce grown for export purposes. For producing KB free wheat, farmers are advised to grow KB resistant varieties recommended for the respective area.

Table 5 : Irrigation scheduling (stage and number) depending on amount of water availability

Stage/Water availability	1 Irrigation	2 Irrigations	3 Irrigations	4 Irrigations	5 Irrigations	6 Irrigations
CRI (21 DAS)	√	√	√	√	√	√
Tiller Completion (45DAS)				√	√	√
Late Jointing/ Boot (65 DAS)			√	√	√	√
Heading/ flowering (85 DAS)		√			√	√
Milk stage (105 DAS)			√	√	√	√
Dough (120 DAS)						√

– In areas where Karnal bunt incidence is low, by growing durum wheat for 2-3 years, fields can become free from Karnal bunt pathogen, *Tilletia indica*

– Zero tillage helps in reducing Karnal bunt incidence.

– Avoid irrigation at heading time.

– One spray of Srizol (Propiconazole 25% EC) @ 375-750 ml/ha or Figon (Tebuconazole 25.9 % EC) @ 750-1000 ml/hec in mid February to control the disease.

Powdery mildew: For the control of powdery mildew in disease prone areas, one need-based spray of **Srizol** (Propiconazole 25% EC) @ 375-750 ml can be given at ear head emergence or appearance of disease on flag leaf, whichever is earlier.

Foliar blight: Foliar blight is the main crop health problem in NEPZ. For effective management of the diseases, cultivation of recommended (resistant) varieties, like HD 2985, HI 1563, DBW 39, CBW 38, NW 1014, NW 2036, K 9107, HD 2733 (resistant to LB), DBW 14, HD 2888, K0307, DBW39 and HUW 468 should be encouraged.

Termite: In the termite prone areas, seed treatment with L-Drint (Chloropyriphos 20% EC) @ 3-5 ml/kg seed is taken up for their management. Seed treatment with **Sawera** (Thiamethoxam 30% FS) @ 7-8 ml/kg seed) is very effective.

Aphids: For the management of aphids, foliar spray of **Dwan Super** (Imidacloprid 30.5% SC) @ 250-300 ml/ha on border rows at the start of the aphid colonization be given. This will help in protection of the bioagent insect, the lady bird beetle inside the field which feeds on aphids.

Ear cockle: Ear cockle is an important disease in eastern parts of India, hence proper precautions be taken, especially in eastern U.P., Bihar and Jharkhand. Farmers should adopt floatation technique for the separation of galls from the infested seed lots. The infested seed lot should be floated in 2 per cent brine solution for this purpose. The galls will float on the surface. These should be separated and destroyed away from the field by burning. The seed should be thoroughly washed to remove the salt solution before sowing.

General tips :

– Choose the best suitable variety for your area and condition.

– Follow timely planting and avoid delay in sowing of wheat crop to avoid yield losses due to adverse effects of heat around maturity.

– Do not grow varieties from other zones to avoid risk of disease susceptibility.

– Manage your crop with optimum inputs (fertilizer, irrigation water, herbicides and fungicides) for maximum yield.

– Timely and judiciously irrigate fields to save water and cut cost.

Harvesting and storage:

Harvesting: The crop is harvested when the grains become hard and the straw becomes dry and brittle.

Yield: The national average yield of wheat grain is about 3 tons per hectare. By adopting improved technology, the crop may yield 5-6 tons per hectare from dwarf wheat varieties under irrigated conditions.

Storage: The storage life of the grain is closely related to its moisture content. Grains with less than 10 per cent moisture store well. The storage pits, godowns etc. should be moisture-proof and fumigated to keep down the stored – grain pests.

Received : *17.03.2018* ***Revised :*** *12.04.2018* ***Accepted :*** *25.04.2018*