



## EVOLUTION OF WHEAT BREEDING RESEARCH IN PUNJAB, PAKISTAN

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Article received on:

02/02/2021

Accepted for publication:

30/03/2021



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### ABSTRACT

There is remarkable history of wheat breeding research in the country. The initial enrichment work on wheat crop in Punjab is dated back to the year 1893 when William James Farrer in Australia distributed a number of crosses for trials at Lahore Botanical Garden but results were very discouraging. An Experimental Farm at Lyallpur was opened in 1901 and some trials of wheat were started there. Agricultural College and Research Institute at Lyallpure was established in 1906. Mr. D. Miline, first Economic Botanist of Punjab became the Head of the Botany Section of the College in 1907. First survey of main wheat growing tracts of the Punjab was made in 1907 and Mr. D. Miline gave out T9 as the first wheat variety in 1911 from the local collection while 8A (approved in 1919) was the first wheat variety to be placed on the Departmental list of Approved Seeds. In 1926, a separate post of Cerealists was created and the work on the improvement of wheat became the sole responsibility to the Cerealists. From 1911 to 1944, eight wheat varieties were approved. Quality was a guiding factor in wheat breeding in the region of Punjab throughout the colonial era. No new wheat variety could be released during first decade after independence. Two varieties C271 and C273 were evolved and released in 1957. First high yielding wheat variety, Mexi-Pak, was approved in 1965. It revolutionized wheat production and Pakistan became pioneer of Green Revolution in wheat production in the region. After Mexi-Pak many world famous varieties like Chenab-70, Lyallpur-73, Yecora, Pak-81, Inqilab-91, Bhakkar-2002, Seher-2006, Faisalabad-2008, Dharabi-11, Galaxy-2013, Bhakkar Star, Ghazi-19 and Akbar-19 were developed and approved from time to time keeping in view the ever changing biological scenario, climate change and prospective consumers/markets. The province is now fastly moving towards Hybrid Wheat though in the trial phases.

KEYWORDS: *Triticum aestivum*; crosses; trials; cerealists; varieties; breeding; high yielding; green revolution; biological; Pakistan

### INTRODUCTION

Wheat (*Triticum aestivum*) is an imperative food crop all over the world. It is the second most preferred human food followed by rice and is being cultivated on huge area than any other crop worldwide. It is the single largest crop in terms of quantum of trade as it is being marketed more than all other crops together. It is consumed by the households in rich, middle-income and low-income countries. During 2018-19, global wheat production was estimated at 732.1 million tons, while global wheat consumption was estimated 751.1 million tons. In the international trade 168.2 million tons wheat was marketed in the same year (FAO, 2019). Plant breeding is the science and art of changing the traits of plants in order to produce desired characteristics. According to Duvick (1986) breeding is about manipulating plant attributes, structure and composition to make them more useful to humans.

Heritable improvements in the wheat plant would increase the returns from this improved food crop. There is little doubt that such improvements have been taking place by the slow processes of nature, the earliest times wheat has been cultivated. The bread wheat being grown now represents the sum of all the evolutionary changes. But these changes are not final. As today, man is systematically changing the wheat plant with improvements in yield and in quality. He is making wheat more resistant to drought, lodging, insects and diseases (Khan, 2011; Chapman *et al.*, 1959).

Wheat spread from its ancient zone of origin in Mesopotamia at the dawn of agriculture (Heisey *et al.*, 2002). Wheat was cultivated in many parts of Eurasia and North Africa by 3000 B.C. In China, its presence was observed in 2000 B.C that reached China by the second millennium B.C (Harlan, 1987). Smale and

McBride (1996) concluded that more recent diffusion of wheat can be described as colonial wheat germ plasm flows, which began about 1500 A.D. Modern scientific plant breeding can trace its development to cereal hybridization or planned cross-breeding which began in England in the 1790s and continued there through the work of Sherriff in the mid-19<sup>th</sup> century. Greater interest in both cross-breeding and better methods of selection in Europe, North America, and Australia started in the last decade of 19<sup>th</sup> century. Wheat improvement began to take the form of crossing of locally adapted material with wheat from other areas to improve production characteristics or quality (Lupton, 1987). Plant breeding in developing world was started in the first decade of the 20<sup>th</sup> century as in India (Jain and Byerlee, 1999). During 1920s and 1930s, the research stations were established in Turkey and planned crosses were completed in Argentina and Brazil in the 1930s. In China, some crossings were prepared during 1920s but introduction of foreign germplasm into planned crossing became famous in 1950s. In this way, it started to replace selection method (Dalrymple, 1986; Smale and McBride, 1996; Yang and Smale, 1996; He and Rajaram, 1997).

## Evolution of wheat breeding research in Punjab

### Colonial period

For the first time in the history of the Indian subcontinent, attempts were made in the last quarter of 19<sup>th</sup> century to study wheat culture. This came in response to the so-called trade compulsion. During that time, wheat shipments had started to sailing to Europe mainly United Kingdom. The grains of early shipments were mixed- grades of red and white and belonging to different species i.e. *Triticum aestivum*, *T. spaerococcum*, *T. turgidum*, *T. durum* and even barley, gram and oilseed. The export shipments of wheat were then in essence mixtures, which fetched low prices in the London market. Consequently, the Secretary of the Bengal Chamber of Commerce requested the governments of Bengal and Punjab to improve the

quality of Indian wheat by promoting pure seed and better crop production practices. As a result, the Commissioner of Settlement and Agriculture of Punjab with the help of District Administration took a survey of wheat production practices and varieties grown in the province in 1883 and collected seed samples from each district of the province. The samples so collected were classified in the Calcutta market through the agency of Messrs. Reinhold & Co (Wace, 1884).

This was the first attempt of its nature in undivided Punjab to classify wheat culture officially and was aimed to address trade concerns. Following conclusions could be drawn from the Tables 1, 2 and 3.

- I. The chief varieties of the Province are club or soft white and soft red. Out of seven million acres' total wheat cultivation, five millions was soft red; and most of the rest was soft white.
- II. The white wheats of Delhi, Umballa, Ferozepore and Dera Ismail Khan were the best in the province as they fetched highest price. The English market, however, preferred white wheat.

Therefore, Colonial Government undertook measures to promote white (amber) wheat. Consequently, efforts for the improvement of white wheat in Punjab started where surplus wheat for export was available. After the Great Famine of 1876-78, a Famine Commission was constituted in 1880. Trade compulsion and the frequent famines added stimuli to the Government to take improvement in agriculture. On the recommendation of the Famine Commission in the year 1898 & 1901 and the Irrigation Commission of 1903, Agricultural Colleges and Research Institutes were established at various places in the country. The agricultural colleges were to be manned by qualified staff and these institutions provided three year courses. Demonstration farms were set up at suitable locations to provide a link between agricultural colleges and districts. In persuance of this scheme, agricultural colleges were started or reorganized at Poona, Kanpur, Nagpur,

Table 1. Trade classification of types of wheat grown in Punjab during 1900

	Trade name	Acres of wheat grown on				Average price per maund of 82 lbs. in January 1884 Rs. as.
		Irrigated land	Land flooded by rivers	Land entirely dependent on rain	Total	
1	Club No. 1	85,139	92172	61260	238571	2 Rs. 14As.
2	Club No. 2	597,613	230108	114739	942490	2 Rs. 11As.
3	Club No. 3	31887	5037	30678	67602	2 Rs. 9As.
4	Number 3	146073	41100	55770	242943	2 Rs. 9As.
5	Soft red	1462755	593216	2334997	4390968	2 Rs. 4As.
6	Hard red	150619	25917	9087	185626	2Rs. 5As.
7	Not classified	274796	189437	570504	1044737	2Rs. 2As
	Total	2758912	1176987	3177035	7112934	

Source: (Wace, 1884)

Table 2. Distribution (000 acres) of wheat varieties in each district of Punjab (1883)

District	White wheat				Red wheat		Not classified
	Club No. 1	Club No. 2	Club No. 3	Club No. 3	Soft red	Hard red	
Delhi	75	-	-	-	64	-	-
Gurgaon	-	-	-	-	66	-	-
Karnal	-	37	-	-	47	11	-
Hissar	-	-	-	-	45	-	-
Rohtak	2	-	-	-	21	-	31
Sirsa	-	3	2	-	23	1	-
Umballa	52	2	-	-	297	-	-
Ludhiana	-	4	5	-	156	8	-
Jullundur	-	7	-	-	311	-	-
Hoshiarpur	1	31	-	-	350	1	-
Kangra	-	51	-	77	1	1	51
Amritsar	-	6	20	-	191	20	53
Gurdaspur	-	52	-	-	291	21	-
Sialkot	-	21	36	-	223	7	3
Lahore	-	160	-	75	158	-	24
Gujranwala	-	-	-	-	176	50	49
Ferozepore	19	26	4	-	300	3	-
Rawalpindi	3	-	-	-	407	-	-
Jhelum	-	-	-	-	-	-	374
Gujrat	-	-	-	-	225	62	43
Shahpur	-	1	-	-	68	-	94
Multan	-	176	-	-	3	-	39
Jhang	-	4	-	71	82	-	9
Montgomery	-	99	-	-	95	-	20
Muzaffargarh	2	63	-	-	79	-	50
Dera Ismail Khan	76	49	-	12	142	-	18
Dera Ghazi Khan	-	140	-	-	-	-	88
Bannu	-	-	-	-	273	-	-
Peshawar	3	1	-	-	176	-	-
Hazara	4	7	-	-	31	-	66
Kohat	-	3	-	8	86	-	-
Total Province	273	943	67	243	4387	185	1042

Source: (Wace, 1884)

Lyallpur and Coimbatore (Gill and Mushtaq, 1998). Punjab Government opened a 56 acre Experimental Farm at Lyallpur in 1901 and some trials of wheat were started there. The experiments were arranged in consultation with Inspector General of Agriculture, India and those experiments were related to classification of varieties, manures, irrigations and other miscellaneous attributes. In 1904, a post of Economic Botanist jointly responsible for Punjab and Uttar Pradesh was approved. Mr. D. Miline joined the Department as the first Economic Botanist. Agricultural College and Research Institute at Lyallpur was established in 1906 and Mr. D. Miline became the Head of the Botany Section of the College in 1907. Mr. D. Miline initiated real work on the improvement of crop plants, particularly wheat and cotton. The initial improvement work on wheat crop in Indo-Pakistan sub-continent dated back to the year 1893, when William James Farrer in Australia distributed a number of crosses, resistant to rust for trials at Kanpur, Nagpur and Lahore Botanical Garden. However, the results

of these experiments were very discouraging. From 1899 onward, some pure lines and crossbred materials from France, Germany, Russia, Canada, Australia and U.S.A were tried at Lahore and later at the Agricultural Farm, Lyallpur, but again the results were far from satisfactory. Some of the Australian hybrids were also distributed amongst the Punjab cultivators in 1901, but with little success (Aziz, 1960).

In the year 1906, the Punjab Board of Agriculture decided to isolate pure lines from local wheats. For this purpose survey of main wheat growing tracts of the Punjab province was made in 1907 and 72 varieties of local wheat were collected from almost all the districts of the Punjab province. After a careful examination of the wheat thus collected Mr. and Mrs. Howard, the Imperial Economic Botanist and the Second Economic Botanist at the Imperial Agricultural Research Institute (Pusa institute) isolated 25 units types belonging to *T. durum* (T1 – T3), *T. sphaerococcum* (T4-T7) and *T. vulgure* (T8-T25) species in 1909.

Later on this work was handed over to Mr. D. Miline

**Table 3. Classification of wheat types grown in chief wheat growing tracts of undivided Punjab**

Type	Ear	Glumes	Grain	Remarks
<i>T. durum</i>				
I	Bearded	Felted yellowish black	White	Awns often black
II	Bearded	Felted white	Red	Awns often black
III	Bearded	Smooth white	White	Awns often white
<i>T. Sphaerococcum</i>				
IV	Bearded	Smooth	Red	-----
V	Beardless	Felted white	White	-----
VI	Beardless	Smooth white	Red	-----
VII	Beardless	Smooth white	White	-----
<i>T. vulgare</i>				
VIII	Bearded	Felted, red	Red	
IX	Bearded	Felted, greyish white	Red	Awns black
X	Bearded	Smooth, red	White	Ripe heads bent over. Ripe straw not pink.
XI	Bearded	Smooth, red	White	Ripe heads erect
XII	Bearded	Smooth, red	White	Ripe heads bent over. Ripe straw pink, occasionally black awns
XIII	Bearded	Smooth, red	Red	-----
XIV	Bearded	Smooth, white	Red	Distinguishable in the field. Early bent heads
XV	Bearded	Smooth, white	Red	Distinguishable in the field late, erect heads
XVI	Bearded	Smooth, white	White	-----
XVII	Beardless	Felted, red	White	Distribution in the field. Ripe head is longer, more lax and erect
XVIII	Beardless	Felted, red	White	-----
XIX	Beardless	Felted, white	White	Ripe head is shorter, denser and bent
XX	Beardless	Smooth, red	White	Distribution in the field. Late ripening
XXI	Beardless	Smooth, red	White	Earlier ripening
XXII	Beardless	Smooth, red	Red	Grain very dark red, hard
XXIII	Beardless	Smooth, red	Red	Grain very light red, entirely soft
XXIV	Beardless	Smooth, white	White	Outer glumes short and rounded
XXV	Beardless	Smooth, white	Red	Outer glumes long and pointed

Source: (Aziz, 1960)

who carried it out very successfully. Mr. D. Miline gave out T9 as the first wheat variety in 1911 from this local collection. Two years later it was replaced by type (T11).

Another extensive local survey was carried out in 1914 in Punjab. Mr. D. Miline isolated the collection into large number of new types over and above the already classified 25 types. One of these, viz., 8A was found to be a definite improvement over T11. After extensive yield trials, it was released for distribution to growers in 1919. It was the first wheat variety to be placed on the Departmental list of Approved Seeds (Aziz, 1960). Work on wheat was carried out by the Economic Botanist, D. Miline upto 1923 and R. B. J. Luthra to 1926. However, a separate post of Cerealist was created in 1926 and the work on the improvement of wheat, which was so far being done under the supervision of the Economic Botanist, became the sole responsibility to the Cerealist. The first incumbent of the newly created post of Cerealist was R.S. Ch. Ram Dhan Singh, who selected another type 9 D, which was found to be the best wheat suited for cultivation under Barani conditions in the Rawalpindi Division and was

approved for Barani tracts in 1932.

The greatest step towards the improvement of Punjab's wheat was taken in 1926 when it was realized that no further progress is possible through pure line selection and hybridization was resorted for the creation of better varieties. These varieties could have all or maximum desirable characters present in more than one type may be combined in one variety. In subsequent years, cross-breeding technique was used to hybridize wheat varieties. The first series of crosses were made between Punjab type 9, 8A and 8B. These types posed certain desirable characters like, high yielding capacity and wide range of adaptability (8A) and stiff stem (T9) but suffered from certain drawbacks like susceptibility to lodging on rich soils (8A), low-yielding capacity and liability to shatter grain (8A) lateness and red color of grains (T9). The first variety, C518 (a cross between T9 x T8) was released in 1933. C 518 is fully bearded, but comparatively short-awned, amber-grained wheat, with white densely felted chaff and grayish black awns. The straw is comparatively short and very stiff, which features, at ripening time, impart to it a characteristics and easily distinguishable appearance and also make

it very much resistant to damage from hails. It is only on very rich soils that it begins to lodge. After C 518, C 591 was the next crossbred wheat to be got ready and placed at the hands of growers, which was done in September, 1934. C 591 is fully bearded, amber grained, with felted chaff and greyish awns. The ears remain erect in the field and distribution of spikelet on them is dense, but not so dense as in C 518. The straw is falling but fairly stiff, so that in height it is generally about three inches taller than 8 A while not so resistant to lodging as C 518 it stands somewhat but decidedly better than 8 A. The second series of crosses were attempted between the Punjab wheat and exotic wheat. As a result of these crosses, the first variety evolved was C 228 (Hard federation x 9 D), which yielded on the average one to two mounds of grains per acre which is higher than C 591 under late sown irrigated conditions. It was approved in 1941, and recommended for cultivation for late sowings in irrigated parts of the province. Another variety C 217 evolved from the crosses between C 516 x C 591 was approved for sowing in the Barani areas of the Rawalpindi Division in 1944. It gave, on an average, one to two mounds of grains per acre more than 8A under Barani conditions. Next cross to follow was C 250 (Hard federation x 9 D) which being resistant to yellow rust under field conditions gave an average grain yield of two to three mounds per acre in excess over C591 under humid climate of sub-mountainous tracts (Table 4). Therefore, it was placed on the Departmental list of approved seeds in 1944. This wheat was suitable for cultivation in the Districts of Sialkot, Gurdaspur and Gujranwala where yellow rust prevailed.

The earlier Lyallpur wheat researchers provided improved wheat varieties to Punjabi farmers throughout the first half of the 20th century. This made the Punjab a major global granary. The Punjab was the grain basket of the Indo-Pak subcontinent and was surplus in food production which used to flow to other parts of the country and exported to Britain and many other countries. Quality was a guiding factor in wheat breeding in Punjab throughout the colonial era. Consequently, quality but not the quantity was a

dominant consideration. The varieties which yielded white attractive chapatti were the consumer's choice (Khan, 1987).

#### Pre semi-dwarf variety era (1947-1965)

With the partition of Britain India, much of the colonial agricultural infrastructure was located in territory belonging to India. West Pakistan inherited the Punjab Agricultural College and Research Station and one provincial experimental station in each of the province of NWFP, Sind and Baluchistan. A small agricultural college was located in Peshawar. After partition, most wheat researchers- mainly Hindus and Sikhs- migrated from West Pakistan to India. This resulted in a serious shortage of wheat researchers in the initial years after independence (CIMMYT, 1989). Consequently, no new wheat variety could be developed from 1947-1956 (Khan, 1987). Two new varieties C271 (C230 x I.P.165) and C273 (C209 x C591) were evolved and released to growers in 1957. These varieties had hard, vitreous grains with good quality gluten strength, making excellent chapattis and had good grain storage characteristics. C 271 was a beardless variety with erect habit of growth and short straw. It had mid-lax pubescent ears. That variety had heavy spikelet and bold grains. It had stiff stem and early in earing. C 275 was a bearded type with erect habit of growth. Its ears were mid-lax and pubescent. The grains were bold and amber colored. It was stiff stemmed and medium in earing (Table 5).

The parents used in wheat breeding prior to 1960s lacked appreciable variability for yield and, therefore, these cultivars had relatively low yield potential. During the early 50 years of research, from 1911 when the first cultivar T9 was released until 1957, the year of the last tall variety, C 273 was approved, maximum yield potential had increased from 2400 to 2525 kg/ha, a gain of only 125 kg/ha in 40 years (Khan, 1987).

#### Green revolution era (1964-1971)

In Pakistan, the decade following independence observed little yield increase. The total domestic wheat availability remained below four million tons

**Table 4. Improved wheat varieties released in Punjab during colonial period (1905-1947)**

Sr. No.	Variety	Year of release	Parentage
1	T 9	1911	Selection
2	T 11	1913	Selection
3	8 A	1919	Selection
4	9 D	1932	Selection
5	C 518	1933	T9 x 8A
6	C 591	1934	T9 x 8B
7	C 228	1941	Hard federation x 9D
8	C 250	1944	Hard federation x 9D

Source: (Khan, 1987)

**Table 5. Wheat varieties released in Punjab from 1947-1963**

Variety	Year of release	Yield potential	Parentage
C 271	1957	2680	C230 x IP 165
C 273	1957	2525	C209 x C591

Source: (Khan, 1987)

and importation became a necessity to augment food supplies. Per capita availability of wheat was around 300 gm per day per person in years immediately following independence. This fell sharply to about 225 gm in the first half of fifties. In the early 1960s, South Asia was facing mass starvation and extreme food insecurity. The pressing food situation in Pakistan and elsewhere in the world set the wheels moving in national and international agencies. Alternative avenues were sought, the methods were revised, a fresh look was given to plant material all over the world. To combat challenge, scientists and governments in the region began assessing the value of the Mexican semi-dwarf for their countries. Trials in India and Pakistan were convincing and demonstrated high yields that offered the potential for a dramatic breakthrough in wheat production. Dr. N.E. Borlaug, a world renowned wheat breeder visited the region in 1960, when he toured India and Pakistan as part of a team of FAO-Rockefeller Foundation scientists (CIMMYT, 1989). Following the visit, Borlaug agreed to provide training for regional wheat scientists and in response Dr. Manzoor Ahmad Bajwa became the first Pakistani researcher to arrive in Mexico in 1961. Mr. Bajwa brought back home some experimental wheat lines which had not yet been approved for commercial release in Mexico. One of these lines was coded CB.90 or 8156. This was a cross between Penjamo 62's' and Gabo 55. That was introduced in Pakistan and segregated for red and white grain color. The white grain version had preferred color and high gluten strength needed to make good chapattis; it was also very high yielding, and showed good resistance against rust and powdery mildew. Though the cross was made in Mexico, line selection was performed by a Pakistani researcher. To commemorate this collaboration, the variety was named MexiPak. In Pakistan, the name MexiPak is synonymous with the success of the Green Revolution. It revolutionized wheat production in the region and Pakistan became pioneer of Green Revolution in wheat production. The red grain sister line of MexiPak was named as Indus 66. Indus 66 had been released in Mexico as the variety Siete Cerros. The cultivation of MexiPak spread out fast and became a dominant variety in Punjab. In three years of time, it had covered 60 percent of the irrigated area. MexiPak was found to be resistant when released, but in the second year of its commercial production, it was reported to be attacked

by race 77 of leaf rust and race 42 of stem rust. It was then decided to develop a few more varieties, as fast as possible, along with it. In the late sixties, two varieties namely Inia and Nortino were given out but none of these was accepted; the former had red grains and the latter shattering problem. A local hybridization program was already in operation. Starting in 1961, scientists at Cereal section, Lyallpur began crossing the Mexican dwarf wheat with the local varieties such as C271 and C273. A high yielding, better high quality variety derived from a cross involving C271 and two other Mexican cultivars (White (E) and Sonora) was developed locally. It out yielded Mexi-Pak by a considerable margin and was later released as Chenab 70. A newly inducted variety Chenab 70 possessed yield response and adaptability of Mexican types and almost resembled C271 in quality characteristics. This wheat variety had excellent grain quality, resistance to new race of rust harmful Mexi-Pak and a yield potential 10 to 15 percent above that of Mexi-Pak, qualities which ensured its enthusiastic reception by farmers. But only 2 years later, in 1972-73, a new race 158 of leaf rust appeared, attacking this variety as well as other varieties in the field. A large number of other lines involving different parents to meet different agronomic needs were developed. Barani 70 was the first semi dwarf wheat specifically developed for rain fed areas and was released in 1970. This variety had excellent drought tolerance and outperformed other Mexican types in a series of trials under rain fed conditions in the central and northern regions. This variety was resistant to the complete spectrum in the year of its release but was attacked by race 158 during 1972-73. SA-42 and Blue Silver (Sonalika) were developed for the shorter-season duration and were released in 1971. SA-42 was a short duration variety suitable for planting after summer crops. Blue Silver, another short duration, was released in 1971 and was suitable for planting as late as the end of December (Table 6).

#### **Post-green revolution era (1971-2019)**

By 1971-72, the dramatic rise in the adoption of new semi dwarf in the irrigated Punjab had largely run its course and most of the initial yield gains associated with the introduction of High Yielding Varieties (HYVs) had been exploited (Table 7). Consequently, the rate of increase in wheat production began to slow and second generation production problems started to appear with

Table 6. Wheat varieties released in Punjab from 1964 to 1971

Sr. No.	Variety	Year of release	Yield potential (kg/ha)	Parentage
1	Mexico-Pak 65	1965	6252	PJ62 'S'/GB-55
2	Chenab 70	1970	6000	C271/WT(E)//SON64
3	Barani 70	1970	5073	P1T/GB//C271
4	SA 42	1971	5513	C271/LR64//SON 64
5	Blue Silver	1971	5757	II-54-388/AN/3/YT.54/N 10 B//LR 64

greater frequency. The improved conditions for wheat were also favorable for the development and mutation of rust pathogens. Although the semi-dwarfs had broader based disease resistance than those of the tall local varieties, they were not immune and eventually began to succumb to new races of the rust. Variety SA-42 became susceptible to leaf rust during 1972-73. Chenab 70 was fallen to rust only after two years of its release. To replace Chenab 70, Lyallpur73 was released in 1973. This variety was highly rust resistant with high yield potential of 60 mounds per acre. During the same year, three other varieties namely Sandal 73, PARI 73 and Pothwar 73 were released for cultivation. Sandal 73 was late variety and approved for cultivation from 3rd week of November to 2<sup>nd</sup> week of December. The variety was resistant to rust and had better grain quality. Its yield potential was 65 maunds per acre. PARI 73 was a triple dwarf variety, responded to heavy doses of fertilizers. The variety was fit for sowing in 3rd week of November. It had yield potential of 70 mounds per acre. Pothwar-73 was a specific purpose long duration variety for rain fed areas or where only 1-2 irrigations were possible. Its yield potential was 50 maunds per acre. SA-75 was approved in 1975 to replace SA-42. It was short duration variety and highly resistant to all the prevailing races of leaf rust. It had wider adaptability and became more popular in rice growing areas due to its high degree of disease resistance. Punjab76 was evolved in 1976 to replace Chenab-70. It had high acceptance and responded well at higher levels of NPK. It had yield potential of 75 mounds per acre. Four varieties Pavon, WL 711, Chenab 79 and Indus 79 were released during 1970s. Bahawalpur-79 was approved in 1979 for Bahawalpur and Multan Divisions. This variety was developed by the wheat scientists of Regional Research Station Bahawalpur having yield potential of 5786 kg/ha. During 1980s, Wheat Research Institute, Faisalabad developed eight varieties including Punjab 81, Pak 81, Kohinoor 83, Faisalabad 83, Faisalabad 85, Punjab 85, Pasban-90 and Rohtas-90. Pak-81 proved mega variety of the institute and was widely accepted by the wheat growers in the country. The variety was resistant to rust and had better grain quality. Pak-81 carried 1B-

1R translocation accommodating linked genes Sr 31, Lr 26, &Yr 9 which was immune to all rust. During the year 1993-94, Pak-81 alone covered 64 percent wheat area of the Punjab. The variety was fallen to rust in early 1990s. Pasban-90 was salinity tolerant variety and was approved for saline areas of the province. Two varieties namely Punjnad- 88 and Wadanak-85 were developed by Regional Agriculture Research Institute, Bahawalpur for Southern Punjab whilst two varieties namely Chakwal-86 and Rawal-87 were developed by Barani Area Research Institute, Chakwal and were approved for Pothwar Region.

During 1990s, sixteen wheat varieties were approved for general cultivation in Punjab. Ten varieties were developed by WRI and three by each BARI and RARI. Wheat varieties developed by WRI included Inqilab-91, Parwaz-94, Shahkar-95, Punjab-96, MH-97, Kohistan-97, Durum-97, Uqab-2000, Chenab-2000 and Iqbal-2000. RARI developed Bahawalpur-97, Drawar-97 and Bahawalpur-2000 whereas Pothwar-93, Kohsar-95 and Chakwal-97 were given by the scientist of BARI, Chakwal. Inqilab-91 was approved in 1991 and replaced Pak-81. The variety had durable rust resistance and had high yield potential and was approved for general cultivation in the whole Punjab. This variety also proved mega variety of the Institute and was accepted by the farmers in the whole country. During 2003-04, Inqilab-91 was being grown on 74 percent wheat area of the Punjab.

Thirteen wheat varieties were approved during 2000s; six by WRI, Faisalabad, four by RARI, Bahawalpur and one by each AZRI, Bhakkar and ABRI. Two varieties namely Shafaq-06 and Seher-06 were approved in 2006 while Lasani-08 and Faisalabad-08 were approved in 2008. These varieties were high yielding and possessed durable resistance to leaf and yellow rust. Lasani-08 is also resistant to stem rust (Ug 99). These varieties were approved for general cultivation in the Punjab. Seher-06 proved mega variety of the institute and covered more than 50 percent wheat cultivation for three consecutive years from 2011-12 to 2013-14. Faisalabad-08, approved in 2008, is still popular among the wheat growers of the province and covered more than 30% wheat area of the province from

Table 7. Salient features of important wheat varieties developed in Punjab

Sr. No	Variety	Institute	Year of release	1000 kernel weight (g)	Bushel weight (kg/hL)	Protein %	Bread Baking quality Scores	Chapati making quality	Yield potential (kg/ha)	Parentage
1	C 518	WRI	1933	33.14	76.3	14.7	62.2	Fair	2890	T9 x 8A
2	C 591	WRI	1934	35.08	77.2	13.7	69.5	Good	2730	T9 x 8B
3	C 228	WRI	1941	38.96	77.5	12.5	78.5	Excellent	2400	Hard Federation x 9D
4	C 217	WRI	1944	33.16	76.2	15.1	70.0	Fair	2000	C516 X C591
5	C 250	WRI	1944	32.06	75.9	15.5	69.4	Good	2400	Hard Federation x 9D
6	C 271	WRI	1957	28.56	71.7	15.8	70.0	Good	2680	C230 x IP 165
7	C 273	WRI	1957	34.60	73.1	15.2	76.0	Excellent	2525	C209 X C591
8	Mexi-Pak 65	WRI	1965	34.54	72.4	12.6	68.5	F. good	6252	Penjamo 'S' /Gabo
9	Indus 66	WRI	1966	33.60	71.8	12.5	69.0	Good	6170	Penjamo 'S' /Gabo
10	Chenab 70	WRI	1970	39.80	74.4	13.2	65.5	Fair	6000	C271/WT(E)//SON64
11	Barani 70	WRI	1970	38.68	71.7	14.1	69.0	Good	6000	P1T/GB/C271
12	SA 42	WRI	1971	48.66	77.7	14.2	69.0	Good	5073	C271/LR64//SON 64
13	Blue Silver	RARI	1971	45.02	77.7	13.2	63.8	Fair	5513	II 53 388/An//Pit 64/3/ LR 64
14	Lyallpur 73	WRI	1973	41.98	76.5	13.0	67.0	F. good	5757	BB/NOR 67
15	Sandal 73	WRI	1973	41.28	77.3	13.1	70.0	Good	5220	CNO//SN64/ KL.REND/3/8156
16	PARI 73	WRI	1973	39.22	71.9	13.4	70.4	Good	6125	CNO 'S'//SON/ KL.REND/3/MEXIPAK
17	Pothowar 73	WRI	1973	38.38	76.5	15.0	68.5	Good	5693	114B-35/NAD 63
18	Yecora	WRI	1975	41.02	74.7	13.8	70.5	V. good	5693	CON 'S'//SON/ KL.REND/3/8156
19	SA75	WRI	1975	33.67	76.4	13.8	72.0	Good	6135	NAI60/CB151//S.948/3/ MEXIPAK
20	Punjab 76	WRI	1976	37.28	75.0	13.0	71.4	F. good	6125	NAI60/CB151//S.948/3/ MEXIPAK
21	LU 26	UAF	1976	39.4	70.2	12.5	80	Excellent	5000	BLUE SILVER/KHUSHAL
22	WL 711	WRI	1978	41.16	77.2	12.9	68.5	Good	5838	S308/CHRIS//KAL
23	Sonalika	WRI	1978	44.80	76.8	12.4	64.4	Fair	6000	II 53 388/An//Pit 64/3/ LR 64
24	Pavon	WRI	1978	30.71	76.9	12.4	73.0	Excellent	5000	VCM//CNO 'S' /7C/3/ KAL/BB
25	Chenab 79	WRI	1979	37.51	80.2	10.9	68.8	F. good	6000	PB-76/CHB 70
26	Indus 79	WRI	1979	40.08	78.6	11.8	77.3	V. good	5000	BB/15.13.5//SON64
27	Bahawalpur 79	RARI	1979	45.2	74.0	12.6	76.5	Good	5786	CNO'S' -IR64 (R)// SON64/ SON (AMBER)
28	Punjab 81	WRI	1981	45.26	76.1	12.2	68.1	Fair	6300	INIA/3/SON64/P.4160(E)// SON64
29	Pak 81	WRI	1981	35.02	72.3	14.4	73.0	V. good	6800	KVZ/BUHO//KAL/BB
30	Kohinoor 83	WRI	1983	36.14	74.7	12.8	66.8	F. good	6000	(OREF1.158/FDL// MEXIFEN 'S' / TIBA 63/3/ COC75
31	Faisalabad 83	WRI	1983	41.70	75.6	12.8	61.1	F. good	6000	FURY//KAL/BB
32	Barani 83	WRI	1983	37.16	72.0	14.7	69.2	F. good	5500	Bb/Gallo/3/Gto/7C//Bb/ Cno
33	Punjab 85	WRI	1985	42.72	78.8	14.6	72.1	Good	6300	KVZ/TRM//PTM/ANA
34	Faisalabad 85	WRI	1985	42.72	78.8	14.6	70.0	Good	5500	MAYA/MONCHO 'S'// KVZ/TRM
35	Wadanak 85	WRI	1985	43.00	79.0	10.4	62.0	F. good	6500	GUIL 'S'//SNIPE 'S'//GDO/ VZ449
36	Chakwal 86	WRI	1986	38.9	78.0	10.6	68.0	V. good	5000	Forlani/ACC//Ana
37	Satluj 86	RARI	1986	37.5	78.0	10.8	67.4	Good	5100	CMT/YR//MON'S'
38	Rawal 87	WRI	1987	40.1	77.5	11.6	68.8	V. good	5200	Maya/Mon's'//Kvz/Trm
39	Punjad 88	RARI	1988	38.5	76.5	11.4	69.0	Good	4500	K.4500*2/BJY
40	Pasban 90	WRI	1990	36.34	77.5	13.7	70.0	Good	6500	INIA66/A.DISTT// INIA66/3/GEN 81
41	Rohtas 90	WRI	1990	35.30	77.6	13.3	69.8	Good	5900	INIA66/A.DISTT// INIA66/3/GEN 81
42	Inqilab 91	WRI	1991	42.36	79.8	13.2	71.5	Good	6800	WL711/CROW 'S'
43	Pothowar 93	BARI	1993	35.9	--	--	--	Good	5000	114B-35/NAD 63
44	Parwaz 94	WRI	1994	46.84	75.6	13.4	69.9	Good	5555	(V-5648) CON 'S' /LR6 4// SON64 /3/ SON/4/PRL 'S'
45	Kohsar 95	BARI	1995	39.5	77.5	12.5	68.5	Good	5000	PNS 'S' /BOW 'S'
46	Shahkar 95	WRI	1996	41.28	77.5	13.0	70.0	Good	5900	WL711//F3.71/TRM
47	Punjab 96	WRI	1996	39.72	75.5	12.9	72.3	F. good	6675	SA42/3/CC//INIA//BB/ INIA/4/CNO/HB832
48	Chakwal 97	BARI	1997	32.0	76.4	12.10	73.2	Good	4900	BU'S' /FCT'S'
49	Bahawalpur 97	RARI	1997	41.9	72.8	12.9	69.0	Good	6200	ORE F <sub>1</sub> 158/FDI/KI/BB/3/ NAC

50	Drawar 97	RARI	1997	40.7	73.7	11.5	68.5	Fair	5757	SASONOKAMWGI/ NORIN//BOW'S
51	MH 97	WRI	1998	37.42	75.0	12.4	72.5	V. good	6800	ATTILA
52	Kohistan 97	WRI	1998	37.40	76.5	13.4	71.3	Good	6100	V-1562//CHRC 'S'/ HORK/3/KUFRA-1/4/ CARP 'S'/BJY
53	Durum 97	WRI	1998	55.60	79.4	10.3	60.0	F. good	7100	JO 'S'/'AA 'S'//FG 'S'
54	Uqab 2000	WRI	2000	43.28	78.4	12.9	72.2	Good	6900	CROW 'S'/'NAC//BOW 'S'
55	Chenab 2000	WRI	2000	45.94	77.5	13.3	73.6	Good	6800	CBRD = CHUM18/BAU 'S'
56	Iqbal2000	WRI	2000	40.00	77.6	13.1	74.0	Good	5500	BURGUS//SORT-12- 13// KAL/ BB/3/ PAK81
57	Bahawalpur 2000	RARI	2000	42.0	75.1	13.3	68.0	Excellent	2000	AU/UP 301//GLL/S <sub>2</sub> /3PWE'S' /4/ MAT'S'/ MAYA'S'//PEW'S'
58	Punjad 01	RARI	2001	39.5	70.2	10.9	69.8	Good	2001	Pb.85/NKT
59	AS 2002	WRI	2002	47.20	76.7	13.3	69.3	F.good	6750	KHP/D31708// CM74A370/3/CIAN079/4/ RL6043/*4NAC
60	SH 2002	WRI	2002	41.68	78.0	13.3	72.5	Good	6900	INQLAB 91/FINK 'S'
61	Ufaq 02	ABRI	2002	37.44	79.0	12.13	67.5	Fair	5400	V-84133/V83150 Biotech- 0(R0)-1(R1)-0(R2)-0(R3)- 0(R4)-0(R5K)
62	Bhakkar 2002	AZRI	2002	45	78.0	11	68.2	F.good	7100	P20102//PIMA/SKA/3/ PTR'S'/BOWS'S'
63	G.A 2002	BARI	2002	36.0	77.5	11.19	68.4	Good	5500	BWL5023/SNB//SNB
64	Manthar 03	RARI	2003	44.0	69.6	12.9	69.5	Fair	6300	KAUZ//ALTAR 84/AOS
65	Seher 2006	WRI	2006	41.83	77.8	12.9	70.2	Good	7000	CHIL/2*STAR/4/ BOW/CROW//BUC/ PVN/3/2*VEE #10
66	Shafaq 2006	WRI	2006	41.40	78.9	14.9	71.9	Good	6000	LU 26/ HD2179//2*INQLAB 91
67	Fareed 06	RARI	2006	42.0	72.9	13.3	70.1	Good	6000	PTS/3/TOB/LFN//BB/4/ BB/HD-832 -5//ON/6/GV/ALD'S'// HPO'S'
68	Mairaj 08	RARI	2008	42.6	71.3	13.1	68.8	Good	7400	SPARROW/INIA//V.7394/ WL 711/3/BAU'S'
69	Lasani 2008	WRI	2008	41.73	83.4	14.4	66.0	Good	6100	LUAN/KOHISTAN.97
70	Faisalabad 08	WRI	2008	42.22	76.4	12.6	70.0	F. good	6732	PBW65/2*PASTOR
71	AARI 2011	WRI	2011	41.76	79.28	11.93	71.45	Good	6563	SHALIMAR 88/90A204// MH.97
72	Chakwal 50	BARI	2008	38.4	75.8	12.70	68.9	V. good	7400	ATTILA /3/ HUI/CARC// CHEN / CHTO/4/ ATTILA
73	BARS 09	BARI	2009	46.48	76.4	10.76	71.2	Good	6000	PFAU/SERI// BOW
74	Punjab 2011	WRI	2011	44.7	75.5	13.72	69.75	Good	6893	AMSEL/ATTILA// INQLAB91/PEW 'S'
75	Millat 2011	WRI	2011	42.84	78.24	13.82	69.53	Good	6358	CHENAB 2000//INQLAB 91
76	Dharabi 11	BARI	2011	42.4	75.6	12.17	68.4	V. good	5500	HXL7573/2*BAU// PASTOR
77	Aas 11	RARI	2011	45.0	74.0	13.2	66.7	Excellent	6678	PRL/ PASTOR//2236(V.6550/ SUTLEJ-86)
78	Galaxy 2013	WRI	2013	45.63	76.21	13.54	68.5	Good	7917	PUNJAB 96/V-87094// MH-97
79	Ujala 16	WRI	2016	42.4	77.6	14.7	68.7	V. good	7500	KIRITATI/4/2*WEAVER/ TSC//WEAVER/3/ WEAVER
80	FatehJang 16	BARI	2016	47.5	78.2	13.0	69.5	Good	5500	ERA F 2000/4/ FONCHAN#3 /TRT 'S'// VEE#9/3/COOK/VEE'S'// DOVE'S'/SERI
81	Ehsan 16	BARI	2016	38	75.10	12.31	69.6	Good	6000	PASTOR/3/ALTAR 84/ AE.SQ. // OPATA
82	Gold 16	RARI	2016	40.3	69.1	13.0	68.7	Good	7900	PR-32(BAU)INQILAB-91
83	Jauhar 16	RARI	2016	40.0	75.7	15.7	69.2	Good	7600	KAUZ/PASTOR//V.3009
84	Barani 17	BARI	2017	34.5	75.8	16	68.1	Good	6500	
85	Anaj 17	WRI	2017	43.7	78.8	15.3	69.2	V. good	7284	BABAX/LR43//BABAX/6/ MOR/VEE#5//DUCULA/3/ DUCULA/4MILAN/5/BAU/ MILAN/7//SKAVZ/BAV92

86	Fakhar e Bhakkar	AZRI	2017	43	777	15	69.3	Good	7300	TTRS/SPA/WL711/3/CHI/4/CROWS/NAC//BOW'S
87	Bhakkar Star	AZRI	2019	45	71	16	70.3	Good	7400	(CHEN/AEGILOPS SQUARROSA (TAUS)//BCN/3/AV92
88	Ghazi 19	RARI	2019	40.2	78.6	15.0	70.4	Good	6700	CNO 79// PF70354/MUS/3/ PASTOR /4/BAV 92/5/FRET2/...
89	Akbar 19	WRI	2019	44.5	79.5	14.0	71.2	V. good	7500	BECARD/QUAIU#1

2017-18 and 2018-19 (CRS, 2019). Bhakkar-2002 was developed by Arid Zone Research Institute, Bhakkar and was approved for arid-zone area of the province. Although variety was approved for arid-zone areas but it became popular among the wheat growers of the whole province of Punjab. The variety covered 27.5 percent wheat area of the province during 2008-09 (CRS, 2013).

Varieties like AARI-11, Millat-11, Punjab-11, Galaxy-13, Ujala-16, Anaj-17 and Akbar-19 varieties were developed by WRI and approved from 2011 to 2019. All these varieties have durable rust resistance, having high yield potential. Galaxy-13 replaced Seher-08 and was reported to be cultivated on 24 percent wheat area of the province from 2016-17 to 2018-19 (CRS, 2019). Four varieties included Dharabi-11, Fatehjang-16, Ehsan-16 and Barani-17 were developed by BARI and were approved for cultivation in Pothwar region; three varieties viz. Aas-11, Gold-16 and Jauhar-16 were developed by RARI and two varieties i.e. Fakhar-e- Bhakar and Bhakar Star were developed by AZRI, Bhakkar.

All institutes like Wheat Research Institute (WRI), Faisalabad, Regional Agriculture Research Institute (RARI), Bahawalpur, Arid Zone Research Institute (AZRI), Bhakkar, Barani Agriculture Research Institute (BARI), Chakwal and Agriculture Biotechnology Institute (ABRI) Faisalabad are working under the umbrella of Ayub Agriculture Research Institute (AARI), Faisalabad.

Wheat Research Institute (WRI) Faisalabad was established in 1975 as a result of the up gradation of Cereal Section Faisalabad. Regional Agriculture Research Station was established in 1950 at Khan Pur and was shifted to Bahawalpur in 1969. It was elevated to Institute in 1987. This institute has developed 14 wheat varieties so far. Barani Agriculture Research Institute (BARI), Chakwal was established in 1979 and started work on the development of wheat varieties in 1983. The institute has developed 11 wheat varieties so far. AZRI was established at Bhakkar in 1991-92 and the institute has developed three wheat varieties. Agriculture Biotechnology Research Institute Faisalabad was established in 1987. The work on

wheat tissue culture/wheat breeding was started in 1996-97. It has developed only one variety i.e. Ufaq-2002.

AARI, Faisalabad has a glorious history and served as beacon to the green revolution in the country and since then consistently playing a key role in meeting the post green revolution productivity challenges. The varieties developed and released so far have been playing a pivotal role for increasing wheat production in the country in general and in the province of Punjab in particular.

From T9 (approved in 1911) to Akbar-19 (approved in 2019), AARI research system has developed 89 wheat varieties so far. The varieties developed by the AARI were widely accepted and opted by the farmers of Punjab. During 2018-19, share of wheat varieties developed by AARI was 99 percent of the total wheat area of Punjab (CRS, 2019).

Beneath the umbrella of Ayub Agricultural Research Institute, Wheat Research Institute, Faisalabad is performing leading role to evolve high yielding but tolerant to biotic and abiotic conditions under climatic changes scenario with 59 wheat varieties followed by Regional Agriculture Research Institute (RARI), Bahawalpur and Barani Agricultural Research Institute (BARI), Chakwal with 15 and 10 wheat varieties, respectively (Table 8).

## SUMMARY AND CONCLUSION

Wheat stretched from its ancient zone of origin in Mesopotamia at the dawn of agriculture (Heisey et al., 2002). Smale and McBride (1996) concluded that more recent diffusion of wheat can be described as colonial wheat germplasm flows, which began about 1500 A.D. For the first time in the history of the Indian subcontinent, attempts were made in the last quarter of 19th century to study wheat culture. This came in response to so-called trade compulsion. The initial improvement work on wheat crop in Punjab is dated back to the year 1893, when William James Farrer in Australia distributed a number of crosses, resistant to rust for trials at Lahore Botanical Garden. First Survey of wheat growing tracts of the Punjab province was made in 1907 and 25 types of wheat were isolated from the lot.

Table 8. A perusal of wheat varieties evolved in various institutes in Punjab during 1911 to 2020

Sr. No.	Institute	Punjab's region	Variety evolved
1	Agricultural Biotechnology Research Institute	Faisalabad	1
2	Arid Zone Research Institute	Bhakkar	3
3	Barani Agricultural Research Institute	Chakwal	10
4	Regional Agricultural Research Institute	Bahawalpur	15
5	University of Agriculture	Faisalabad	1
6	Wheat Research Institute	Faisalabad	59
	Total		89

Agricultural College and Research Institute at Lyallpure was established in 1906 and Mr. D. Miline became the Head of the Botany Section of the College in 1907. Mr. D. Miline initiated real work on the improvement of crop plants, particularly wheat and cotton. He gave out T9 as the first wheat variety in 1911 from the local collection and T11 in 1913. Another extensive local survey was carried out in 1914 in Punjab. Mr. D. Miline isolated the collection into large number of new types over and above the already classified 25 types. The first wheat variety to be placed on the Departmental list of Approved Seeds was 8A which was released in 1919. Work on wheat was carried out by the Economic Botanist, D. Miline upto 1923 and R. B. J. Luthra to 1926. In 1926, a separate post of Cerealist was created and the work on the improvement of wheat became the sole responsibility to the Cerealist. The greatest step towards the improvement of Punjab wheat was taken in 1926 when hybridization was resorted for the creation of better varieties. The first variety, C518 (a cross between T9 X T8) was released in 1933. After C 518, C 591 was released in 1934, C228 in 1941 and C250 in 1944. The earlier Lyallpur wheat researchers provided improved wheat varieties to Punjabi farmers throughout the first half of the 20th century. This made the Punjab a major global granary. The Punjab was the grain basket of the Indo-Pak subcontinent and was surplus in food production which used to flow to other parts of the country and exported to Britain and many other countries. Eight wheat varieties were approved from 1911 to 1944. No new wheat variety could be released in Punjab during first decade after independence. Two varieties C271 and C273 were evolved and released in 1957. In 1961, Manzoor Ahmad Bajwa, a trainee studying at CIMMYT, identified a medium-to-hard white-grain line from the segregating generations of the cross 8156 or CB.90. This was a cross between Penjamo 62'S' and Gabo 55. CB 90 was segregated for red and white color. The white grain version had the preferred color and high gluten strength needed to make good chapattis. He took this seed back to Pakistan and after yield testing; it was released for general cultivation. To commemorate the collaboration between Pakistan and Mexico, the variety was named Mexipak-65. Mexipak-65 revolutionized

wheat production in Punjab and Pakistan became pioneer of Green Revolution in wheat production. A large number of other lines involving different parents to meet different agronomic needs were developed. Thus cultivars with varying maturity range, agronomic characteristics and fertilizers and irrigation needs were developed. Followings are the conclusions:

1. The initial improvement work on wheat crop in Indo-Pakistan sub-continent dated back to the year 1893, when William James Farrer distributed a number of crosses for trials at Kanpur, Nagpur and Lahore Botanical Garden.
2. First survey of main wheat growing tracts of the Punjab province was made in 1907 from almost all the districts of the Punjab province and 25 units types belonging to *T. durum* (T 1 - T3), *T. sphaerococcum* (T4 - T7) and *T. vulgure* (T8 - T25) were isolated.
3. Mr. D. Miline gave out T9 as the first wheat variety in 1911 from this local collection.
4. Another extensive local survey was carried out in 1914 in Punjab and the collection was isolated into large number of new types over and above the already classified 25 types.
5. A was the first wheat variety by the Department and was released in 1919.
6. In 1926, a separate post of Cerealist was created and the work on the improvement of wheat became the sole responsibility to the Cerealist.
7. Eight wheat varieties were released in Punjab during the colonial period and quality was a guiding factor in wheat breeding throughout the colonial era.
8. After partition, most wheat researchers migrated from West Pakistan to India. Consequently, no new wheat variety could be released from 1947-1956 and only two varieties C 271 and C 273 were released to growers in 1957.
9. Mexi-Pak 65, released in 1965, revolutionized wheat production in the region and thus Pakistan became

pioneer of Green Revolution in wheat production.  
10. After Mexi-Pak 65, seventy-eight (78) wheat varieties were released for cultivation in different agro-ecological zones of Punjab.

The research work on Hybrid Wheat is in the trial phases for the last couple of years in Agricultural Universities of the Punjab. There is likelihood of its commercial release within next couple of years.


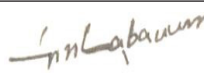
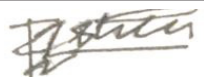

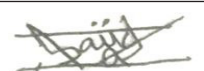
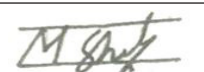
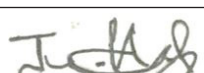

### ACKNOWLEDGEMENT

We, owe a debt of gratitude to all those wheat scientists who have helped us in completing this manuscript. Our special thanks are extended to Dr. Lal Hussain Akhtar, Director, RARI, Bahawalpur, Mian Muhammad Ashraf (Ex-Wheat Botanist), Mr. Muhammad Rafique, Director BARI, Chakwal, Mr. Muhammad Ramzan, Director, AZRI, Bhakkar and Dr Kashif Aslam, Associate Professor, Department of Plant Breeding & Genetics, University of Agriculture, Faisalabad for providing basic information on varietal yield trials and parentages of the wheat varieties developed by their institutes. Their efforts in arranging data with meticulous care are highly appreciated.

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Sr.No.	Author's name	Contribution	Signature
1	Mohammad Ishaq Javed	Collected data and prepared write up	
2	Muhammad Ijaz Tabassum	Prepared final manuscript	
3	Iftikhar Nabi	Assisted to write up the manuscript	
4	Asghar Ali	Supervised the study	
5	Sajid-ur-Rahman	Helped in review of literature	
6	Shoaib Kamran	Assisted to complete write up	
7	Javed Ahmad	Helped plan the study	
8	Muhammad Usman	Helped in material collection from different sources	
9	Obaid Ullah khan	Reviewed the manuscript	