Development of Triticale

Patil Kulbhushan Savindra[1], Shivashish Varma[2], Anand Bunga Paul[3]

School Of Agriculture, Lovely Professional University,Phagwara.

Mail. ID. - kulbhushanpatils1008@gmail.com

More wheat *(Triticum aestivum* L.) is produced annually than any other cereal crop and only rice (*Oryza sativa* L.) approaches wheat in the amount produced each year. Wheat is used principally as food and provides more nourishment for people than any other food source. It has been a basic food throughout recorded history. Evidence suggests that wheat was grown as a food crop as early as 8000 to 10 000 B.c. The earliest forms of wheat probably were the non-free threshing emmer wheat types. The role of wheat as livestock feed throughout history has been less important than its role as human food. The direct use of wheat as livestock feed generally has been reserved to times of surplus in developed countries. However, as a by-product of modem milling, as much as 28% of the wheat grain, mainly bran and shorts, finds its way into mixed livestock feeds **(Inglett, 1974).**

No cereal is as versatile as wheat for food. An array of products is made from wheat-the principal one being baked leavened bread in developed countries and unleavened baked bread the more common form in developing countries. Other foods in which flour milled from wheat is the main ingredient include pastries such as sweet rolls, cakes, doughnuts, cookies, pie crust, and other popular items such as crackers, biscuits, muffins, pancakes, waffles, noodles, spaghetti, macaroni, and pizza.

The favored role of wheat as food is associated with its protein, which is unique among the cereals. The ability of wheat to be prepared as leavened bread results from the properties of the gluten protein fraction to trap and retain C02 generated during fermentation of the dough. No other cereal, except rye *(Secale cereale* L.) and triticale (X. *Triticosecale)* to a limited degree, possesses these unique protein properties. Wheat is palatable, nutritious, and readily processed. Its products are bland and suit the tastes of people throughout the world.

Triticale is a wheat-and-rye hybrid that was artificially produced; it has all the chromosomes of both of its parents. Compared to wheat and rye, its history has been incredibly brief. In marginal growing areas where the crop has an advantage over wheat, production should rise. Triticale can be processed using the same methods and machinery as wheat and rye with just minimal adjustments. Triticale has had some success as a replacement for conventional wheat products. Despite the mixed results of feeding trials, triticale's slightly better protein content and quality (more lysine) continue to inspire hope for its potential as a feed grain. The fact that rye was very winter-hardy and a close relative of wheat led me to believe that a cross between these two cereals might result in a variety having the hardiness of rye combined with the milling qualities and other desirable characteristics of wheat.

Hexaploid triticales, which are amphiploid hybrids of tetraploid wheat and rye, and octoploid triticales, which are amphiploid hybrids of hexaploid wheats, are the two main families of triticale. Tetraploid forms have just recently been reported **(Krolow, 1973)**. Wilson provided the first account of wheat-and-rye hybrids in 1875. The hybrids were completely infertile and incapable of procreation. In 1914 four natural wheat- rye hybrids are found. Three of these were found growing in the wheat plots on the Arlington Experiment Farm, of the United States Department of Agriculture, near Washington and fourth one was sent to Leighty C.E. for identification from Tennessee.

The, hybridization of wheat with rye presents no special technical difficulties, as has been shown by a whole series of investigators. Beginning with the eighties of last century, Carman in America, Rimpau and Tschermak in Germany, Jesenko in Austria, etc. were successful in their attempts at artificially producing hybrids of wheat with rye. There also exist many indications as to the occurrence of natural wheat-rye F 1 hybrids in wheat sowings **(LeighV, 1920; Meister, 1921; Neister and Neister, 1924).**

Plant hybrids that contain the diploid chromosome complement of the parents have been described in the recent years by a number of investigators. They occur rarely and are produced in combinations which usually are highly infertile or self- sterile in the F1 generation. Some investigators have designated such hybrids as “amphidiploids” to call attention to the presence in one plant of the both parental chromosome sets in the diploid condition. Most of the known amphidiploids have been produced from interspecific and intergeneric artificial hybrids.

They are of special interest to geneticists and cytologists on account of the light they shed on methods of species formation and also account for their possibilities for plant improvement.

1. The Development of Hexaploid Triticale-

Two important developments occurred during the late 1930's that dramatically affected triticale research. First was the discovery that colchicine could be used to induce chromosome doubling so that new amphiploids could be produced routinely **(Kostoff, 1938).** Second, during the same period improvements in embryo culturing had developed so that hybrids could be obtained from normally cross-incompatible parental combinations. These developments paved the way for the production of hexaploid triticales from hybrids between tetraploid wheat and rye**.** The first hexaploid tritical was reported by **Derzhavin (1938)** from the cross durum wheat x *Secale montanum.*

A hexaploid triticale from a durum wheat x cultivated rye, S. *cereale*, by O'Mara **(1948)** was to play an important role in the development of triticale in North America and Europe. Soon numerous new hexaploid triticales were being produced from combinations of different tetraploid wheats and diploid ryes **(Nakajima, 1952, 1958, 1963; SBnchez-Monge *et al.*, 1956, 1959; Pissarev, 1963; Kiss, 1966; Larter, 1968; Jenkins, 1969; etc.**).

Muntzing (1972) indicated that the first hexaploids to be produced had such poor seed development that researchers were not encouraged to work on a form which appeared to have so little economic potential. However, those produced by O'Mara and Sgnchez- Monge were more promising.

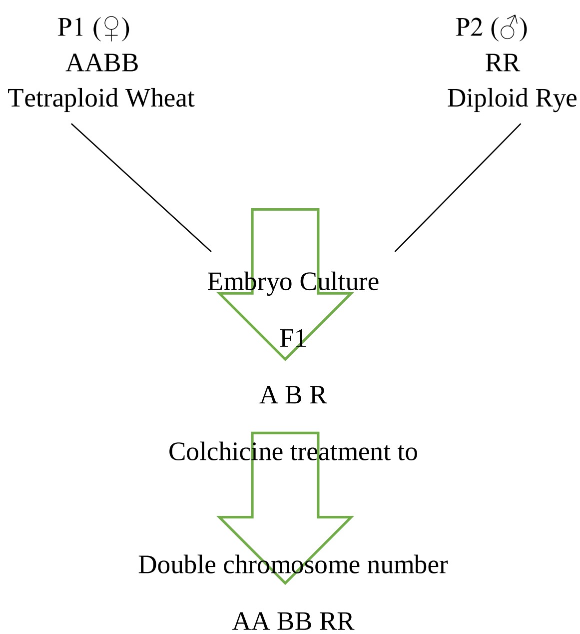

Fig. 1. Primary Hexaploid Triticale

2. The Development of Octaploid Triticale-

The first report of hybrids between wheat and rye was published by Wilson in 1875. The hybrids were highly sterile and did not reproduce. Rimpau, a German scientist, obtained a fertile, true-breeding strain from a cross between bread wheat and rye in 1891. It was not until 1935 that this strain was proved to be an amphiploid with *2n* = 56 chromosomes **(Lindschau and Oehler, 1935; Muntzing, 1936).**

According to **Muntzing (1973)** an unusual outcrossing phenomenon was observed in 1918 by Meister at the Saratov Experiment Station in Russia. Thousands of natural wheat-rye hybrids occurred in wheat plots which had been adjacent to rye plots the previous year. He reproduced plants from these hybrids for several generations and eventually obtained true-breeding, more or less fertile derivatives. In 1930 Meister gave a botanical description of the new species and named it *Triticum seculotricumsurutoviense* Meister. **Lewistsky and Benetzkaja (1931)** produced cytological evidence that the new forms produced by Meister from the bread Wheat x rye crosses amphiploids with *2n* = 56 chromosomes. They also observed univalent and other meiotic irregularities. They assumed that incompatibility existed among chromosomes between parental genomes. Since disturbed pairing could not be due to a lack of chromosome homology, they believed that the amphiploids arose as a result of an apogamous development of F, ovules having a somatic chromosome number and that this was doubled during the first division of the egg cell.

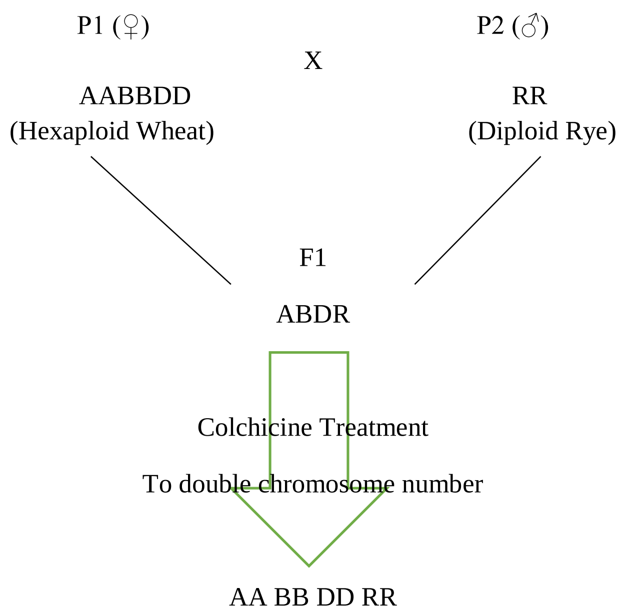

Fig. 2. Primary Octoploid Triticale

- **Merits and Demerits** of **Octoploid Triticales**

The octoploid triticales have good winter hardiness and have early flowering and seed maturity. The protein content is higher and baking qualities are good. Among the disadvantages is partial sterility, which is partly compensated for by large kernels. Octoploid triticales in rainy weather used to sprout at harvest time. Breeding work can, however, overcome the negative characters. The recombinant strains of octoploids were found to have a low frequency of aneuploidy and sterility and the euploids had higher fertility than aneuploids **(Weimarck, 1973).** The octoploid triticales have been found to be superior at higher altitudes in China and are cultivated in the Yunnan Kweichow plateau of southwestern China and also in Ningsiahui country in North China **(Muntzing, 1979).**

- **Problems, Progress and Research needed-**

The wheat-rye hybrids were initially produced with a view to transfersome of the desirable attributes of rye to wheat. As a consequence the present day triticales, both octoploid and hexaploid, possess a number of desirable attributes: (1) they possess winter hardiness derived from rye and therefore were found to survive in severe winters, when wheat cultivars used as standards were destroyed or damaged; (2) they possess the ability to grow on light soils (medium light to pure sand); (3) like rye, particularly octoploid winter triticales possess early flowering, seed maturity, and harvest; (4) octoploid triticales have larger kernels (average 1000 kernel weight is 50 g in octoploid triticale and 40 g in wheat) and higher protein and lysine content relative to hexaploid wheat (protein content 18.41% in octoploid triticales and 13.51% in wheat according to Muntzing, 1979).

At altitudes of 2000 m and above, both octoploid and hexaploid triticales have shown competitive performance with wheat in China, India, and Mexico. Recently hexaploid triticales have also shown their ability to compare well with hexaploid wheat or out yield it (cultivar Welsh in Canada and Coorong in Australia) and acquire resistance more easily than wheat **(Wabwoto, 1974; Srivastava, 1974).** Thus remarkable progress in the improvement of hexaploid triticales is known to have been made through the work conducted in several countries. However, the work carried on in Sweden by Muntzing and his coworkers with patience and perseverance led to considerable improvement in octoploid triticales.

Notwithstanding the desirable attributes described above, both in octoploid and hexaploid triticales, there are some serious problems, which have received the attention of triticale workers in recent years: (1) there is meiotic instability, aneuploidy, and partial sterility both in octoploid and hexaploid triticales, due to which ears are not well filled with kernels (like wheat and rye), although in octoploid triticales, this drawback is partly compensated by large kernel size; (2) kernels are often shriveled both in octoploid and hexaploid triticales, which leads to lower values of test weight than in wheat (3) octoploid triticale and to some extent even hexaploid triticale kernels have a tendency to sprout before harvest, if the weather is rainy. This is correlated with a high amount of a-amylase (Muntzing, 1979); (4) there are problems concerning diseases and nutritive aspects; (5) there is also the problem of lodging in octoploid triticales, which reduces the yield. These problems and the progress achieved as well as the possibility of overcoming these problems in the future will be discussed in this section.

Triticale is destined to take its place as an important new component of the world's spectrum of food and feed grains. Its high yield capability, combined with the satisfactory biological quality of its protein and its adaptability to environments unsuitable for wheat, given ample cause for optimism concerning its future production **(Hulse, 1974).** Several improvements, however, will have to be made before the full potential of this first manmade cereal grain can be realized. The research objectives for the improvement of triticales stated by Zillinsky and Borlaug (1971b) for the CIMMYT program apply to all research institutions working with triticales. They have been summarized as follows:

The Attack on Factors which Directly Negate High Grain Yield:

1. An attempt to correct sterility and develop triticales equal in fertility to the best bread and durum wheats.
2. An attempt to overcome grain endosperm shriveling and improve grain plumpness and test weight.
3. An attempt to introduce early maturity genes.
4. An attempt to introduce dwarfing genes, since triticales are tall growing and susceptible to lodging when grown under heavy fertilization and irrigation.

The Attack on Factors Affecting Yield Stability:

5. An attempt to introduce genes for photoperiod insensitivity, thereby permitting flexibility in dates of sowing.
6. An attempt to introduce genes to widen the zone of adaptation.
7. An attempt to introduce genes to broaden the spectrum of disease resistance.

Triticale does not yet have a competitive advantage over wheat or other cereal grains except in some specific environments, such as high elevations, in areas where cool early growth temperatures prevail, and on sandy or low fertility soils. Considerable breeding work still remains to be done. The most serious agronomic problems are grain shriveling, pre-harvest germination, the tendency to produce few tillers under stress conditions, a narrow range of adaptation, and susceptibility to ergot. Considerable research is still required to improve its physical properties for the production of commercial food products.

References-

Inglett, G. E. (1974). Wheat in perspective. *Wheat: Production and utilization. Avi Publishing Co" Westport, Conn*.

Krolow, K. D. (1973). 4x triticale production and use in triticale breeding. In *Proc. 4th Int. Wheat Genet. Symp* (pp. 237-243). Columbia, Missouri.

Leigh, A., & Van Der Eng, P. (2010). Top incomes in Indonesia, 1920-2004. *Top incomes over the twentieth century*, *2*, 171-219.

Meister, G. K. (1921). Natural hybridization of wheat and rye in Russia. *Journal of Heredity*, *12*(10), 467-470.

Kostoff, D. (1938). Studies on polyploid plants. *Journal of Genetics*, *37*(1), 129-209.

Ammar, K., Mergoum, M., & Rajaram, S. (2004). The history and evolution of triticale. *Triticale improvement and production*, *1*, 1-10.

Sanchez-Monge, E. (1974). Development of triticales in Western Europe. In *Triticale: proceedings of an international symposium*. IDRC, Ottawa, ON, CA.