AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 02 Issue: 12 December 2021 Article No: 16

Wide Hybridisation: Breeding Tool for crop Improvement

Aware S. A.
Agricultural Assistant, Vasantrao Naik Marathwada Krishi Vidyapeeth Parbhani (M.S.)

SUMMARY

Wide crosses plays important role in crop improvement as they become useful tool in transmitting genes into cultivated cultivars from wild forms and relatives for disease resistance and for improvement in quality parameters in various cultivated plant species. Apart from uses, wide crosses should contain certain issues like cross incompatibility, hybrid inviability, and hybrid breakdown and hybrid sterility. Certain techniques are used to overcome these issues like pollen mixture, bridge crosses, manipulation of ploidy level, embryo rescue.

INTRODUCTION

Hybridization is the crossing between two genetically dissimilar parents while hybridization among entities from diverse species of the same genus i.e. intrageneric hybridization and two diverse genus of same family i.e. intergeneric hybridization combinedly known as distant hybridization and such crosses are known as distant crosses or wide crosses. Thomas Fairchild (1717) was the pioneer who performed distant hybridization for the first time by developing a hybrid by crossing Carnation (Dianthus caryophyllus) and Sweet william (Dianthus barbatus). First intergeneric hybrid, between Brassica (cabbages) and Raphanus (radish) was given by Karpechenko (1928) leading to the production of Raphanobrassica. Whereas,Triticale was developed by crossing wheat with rye (Rimpu,1890) possessing higher potential than raphano brassica (Allard 1960).

Problems Associated with Wide Crosses:

Problems related with performing distant crosses are:

Cross Incompatibility:

It is illustrated as incompetence of fully matured pollen grains of one generaor breed to fertilize other genera or breed. There are three main reasons of cross incompatibility viz.

- Abscence of pollen germination,
- Inadequate development of pollen tube to reach ovule and
- Failure of fusion of microgamete with mega gamete.

These barriers are called as pre –fertilization barriers. Such barriers can be overthrown with the exploitation of various techniques like reciprocal and bridge crosses, utilization of pollen mixtures, pistil manipulations and growth regulators etc.

Hybrid Inviability:

Condition in which zygote or embryo becomes inviable or fails to develop further or initial stages are completed but it gets aborted is described as hybrid inviability.

Major causes for this condition are:

- Adverse interactions occurring among the chromosomes of the two species
- Hostile interaction of the endosperm with the embryo.
- Disharmony between cytoplasm and nuclear genes

In order to overthrow these situation techniques like making reciprocal crosses, use of hormones required for growth and preventing embryo abortion through its rescue can be exploited.

Hybrid Sterility:

It specifies the situation in which hybrid produces progeny which is non-viable in nature. This is more prominent in the case of intergeneric crosses. The major reason for hybrid sterility is the lack of structural homology between the chromosomes of the two species. Sterility occurring due to difference in structural homology among the chromosomes of two species can be overpowered by the use of colchicine treatment.

Hybrid Breakdown:

It is the major issue in interspecific crosses.

- The condition in which first filial (F1) hybrid plants of intrageneric cross are fertile and vigorous but their next generation i.e. F2 progeny looks like weak and finally becoming sterile is called as breakdown of hybrid.
- So hybrid breakdown hinders the progress of interspecific gene transfer.
- This may be due to the structural difference of chromosomes or problems in gene combinations (Singh 2010).

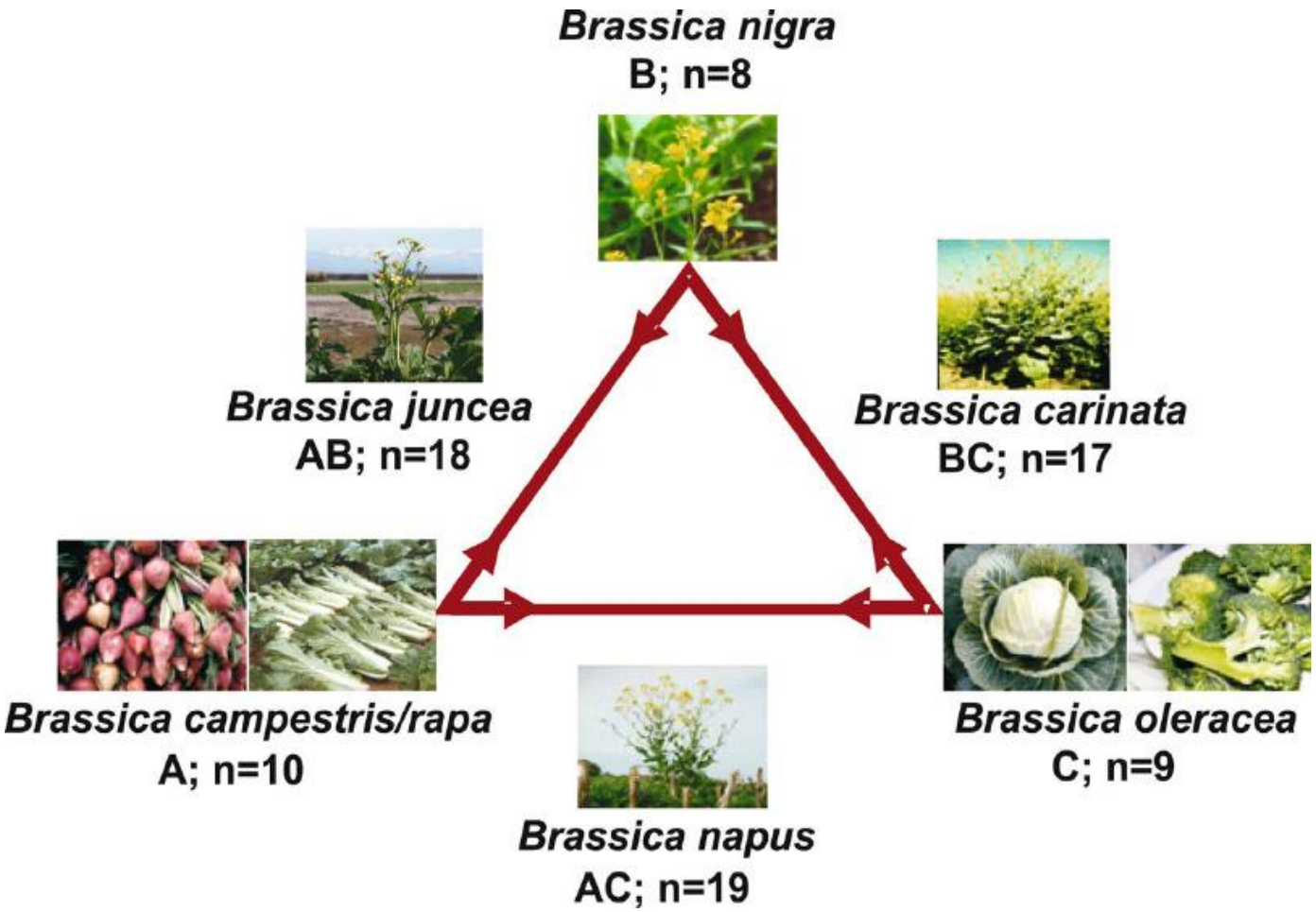

Fig: U Triangle of Brassica evolution

(**Source**:https://www.google.com/url?sa=i&url=https%3A%2F%2Fbotanyshitposts.tumblr.com%2Fpost%2F166038027016%2Fsquareallworthglumshoeglumshoe&psig=AOvVaw2I7ApaTlfebgXy3bO25ECg&ust=1637925602357000&source=images&cd=vfe&ved=0CAgQjRxqFwoTCNjQsbKys_QCFQAAAAAdAAAAABAM)

Different approaches for making distant crosses successful

- Plant Selection Cross compatible plants should be selected as parents for doing crosses.
- Reciprocal crosses under the situation of failure of one parental combination, crosses in the reciprocal manner can be performed. e.g. Mung x udid- cross compatible and Udid x Mung-cross incompatible.
- Handling of ploidy Copies of single genomes through colchicine treatment can be made to retain the fertility of a cross.
- Bridge crosses when a cross is to be made between two cross incompatible species, a species which is compatible with both the other species is used as a bridge for achieving the cross. Such type of species is known as bridging species. e.g. Tobacco –

  a) Nicotiana repanda x N.tabaccum– cross incompatible

  b) Nicotiana repanda x N.sylvestris- cross compatible

  c) Product x N.tabaccum- cross compatible

- Utilization of mixtures of pollen for overpowering the adverse interactions among pistil and pollen in distant crosses pollens from diverse plants can be utilized for pollination.
- Pistil Manipulations for overpowering incompatibility beheading of style can be done.
- Applications of growth hormones development of pollen tube is increased with the use of IAA, NAA, 2,4-D and Gibberellic acid.
- Protoplast fusion of protoplasts can be performed under the condition of failure of gamete fusion.
- Prevention of embryoabortion - Embryo rescue technique can be attempted to overcome embryo abortion.
  - Ex. Hordeum. vulgare x Secale cereale.
  - Degradation of endosperm cane be overpowered through rescue of embryo (Allard 1960).

Types of Distant Hybridization

- Interspecific Hybridization
- Intergeneric Hybridization.

Interspecific Hybridization

Interspecific hybridization crossing between two different species of the same genus is termed interspecific hybridization or intra-generic hybridization. Such crosses are called interspecific crosses and progeny of such cross is called interspecific hybrid. Interspecific hybrid was first developed by Thomas Fairchild in 1717 between sweet William and carnation species of Dianthus (Dianthus barbatus x D. canyophyllus)

Main features of interspecific Hybridization

- It is used when the desirable character is not found within the species of a crop.
- It is an effective method of transferring desirable genes into cultivated plants from their related cultivated or wild species.
- Interspecific hybridization is more successful in vegetatively propagated species like sugarcane and potato than in seed propagated species.
- Interspecific hybridization leads to introgression which refers to transfer of some genes from one

Intergeneric Hybridization:

Intergeneric hybridization refers to crossing between two different genera of the same family. Such crosses are rarely used in crop improvement because of various problems associated with them.

The main features of intergeneric crosses are given below:

- Intergeneric hybridization is used when the desirable genes are not found in different species of the same genus.
- This method is rarely used in crop improvement programmes and that too for transfer of some specific characters into cultivated species from allied genera.
- Intereneric hybridization has been generally used in asexually propagated species.
- F1 hybrids between two genera are always sterile. The fertility has to be restored by doubling of chromosomes through colchicine treatment.
- Intergeneric hybridization was used by some workers to develop new crop species.
- Species into the genome of another species.

CONCLUSION

We can enhance the overall development of crops by increasing the level of disease resistance, pest resistance, stress resistance, quality, adaptation and yield, distant Hybridization acts as an important tool for the same. Furthermore, they can be utilized for evolving new crop species such as Cotton: Interspecific Hybridisation : MCU-2, MCU-5, Khandwa1, Khandwa 2,Varlaxmi,Savitri,DCH-32, NHB-12, DH-7, DH-9 and Bhindi : Parbhani Kranti

REFERENCES

Allard, R. W. (1960). Principles of plant breeding. John Wiley and Sons, Inc., New York. Harlan, J.R. (1976). Genetic resources in wild relatives of crops. Crops. Sci. 16: 329-333.

Kaneko Y, Bang SW (2014) Interspecific and intergeneric hybridization and chromosomal engineering of brassicaceae crops. Breed Sci 64:14–22

Knott, D.R. and Dvorak, J. (1976). Alien germplasm as a source of resistance to diseases. Ann. Rev.Phytopath, 14: 211-235.

Meyer, V.G. (1974). Interspecific cotton breeding. Econ. Bot.28: 56-60.

Simmonds, N.W. (1979). Principles of crop improvement. Longman, London and New York.

Singh, P. (2010). Essentials of plant breeding. Kalyani Publication, New Delhi. 4thedition: 240-254.

Stalker, H.T. (1980). Utilization of wild species for crop improvement. Adv. Argon. 33: 111-147.

www.biologydiscussion.com