



# Sexual Crossing Breeding and Transformation Gene Breeding of Crops

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## Abstract

In this paper on basis of feature of sexual crossing breeding and transforming gene breeding: breeding nature, relationship between the two, limitations of molecule breeding operation and amazingly high input, affects of production of Original Theory of Botany (Crop Science) on the two breeding ways were discussed to determine these foreground and future relations. Molecule breeding was a closed breeding that cannot increase yielding ability and it always cannot do without sexual crossing breeding that gave acceptor. Only sexual crossing breeding was an open breeding that can increase yielding ability. Only rely on molecule breeding operation cannot produce whole plant and cannot accomplish generation transmission. Amazingly high input of transformation gene breeding made it hard to continue, especially basic research of molecule breeding consumed maximum made it difficult to conduct, and the duration was too long to lead to the lose outweighs the gain. Production of Original Theory of Botany (Crop Science) was especially advantageous for sexual crossing breeding and made it successfully transforming into scientific breeding and increasing breeding effect in big range. Sexual crossing breeding will become always leading breeding way, but transformation gene breeding or molecule breeding supplementary.

## Subject Areas

Agricultural Science

## Keywords

Crop, Crossing, Transformation Gene, Breeding

## 1. Introduction

Transformation gene breeding of two genes, resistance to insect and resistance

to herbicide were accomplished in eighty age in above century by USA. It started a guide for transformation gene breeding of crops, especially transforming special resistance gene from distant plant to increase ecological-adaptability and yielding stability of crops. But due to its negative effect, great majority states prohibited transformation gene breeding of grain ration crops or planting transformation gene cultivars. Transformation gene breeding was greatly supported and absorbed in great amount of fund but made progress a little in initial stage in this century in a big nation.

Sexual crossing breeding was still lead way of crop breeding in present in the World. What was leading way of crop breeding in future? Transformation gene breeding or sexual crossing breeding? This not only was an academic problem, but also a big society problem.

Using sexual crossing breeding means to transforming external blood gene was a general method, according to strictly academic significance it yet was not transformation gene breeding, only first time introducing external blood gene to be successful clone from and into crop body and made it successfully expressing, only this process could be called transformation gene breeding. But these all were called transformation gene varieties for raising social status in China. This doing had suspicion exaggerating oneself contribution and usurping contribution of true transformation gene breeder, could use proper method to distinguish. In this paper comparison study between sexual crossing breeding and transformation gene breeding was conducted and some discussions suggested.

## 2. Concerning Breeding Nature

Sexual crossing breeding belong to open breeding, and transformation gene breeding closed breeding. This was most intrinsic difference of the two breeding way [1]. This theory was produced under guiding by Original Theory of Botany (Crop Science) [2]. Open breeding and closed breeding also were most intrinsic and different nature concept.

Transformation gene breeding cannot increase yield ability of a variety, this was its most shortcoming. Because Introducing gene must take up energy from acceptor to use self expression, reduced energy supply for yield ability characteristic, but closed acceptor cannot increase itself energy. The more expression of transforming gene needed energy, the more reduced yield. Sexual crossing breeding belong to open breeding. Its outstanding feature was that whole gene system all participated recombination and forming chain improvement of voluntary selection characters and non-voluntary characters, due to these improvement more energy was absorbed and used in environment, ensured improvement adaptable-ecology character and yield ability character and increased yield or improving quality. Open nature of sexual crossing breeding decided that it will be always invincible position, any breeding way all cannot replace it. Belong to closed breeding way, had:

- 1) Natural mutation of gene in a variety

- 2) Selection of isoline and near isogenic line
- 3) Backcross breeding for a resistance
- 4) Transforming gene breeding for ecological adaptability and quality character
- 5) Physical and chemical mutation breeding in general situation
- 6) Astronavigation breeding (space breeding) in general situation
- 7) DNA fragments import in general situation

These breeding ways all cannot increase yield ability and breeding effect was bad, so a little breeder doing it.

Sexual crossing breeding was best breeding way and reproductive way passing long period nature and artificial selecting. It was simple and convenient easily doing, can immediate observe whole plant and easily select. Sexual crossing breeding yet had one hundred and twenty years history from 1900 year, in all of more than ten new and old breeding ways, sexual crossing passing long period accumulation, had the most and bigger, the biggest achievement and the lowest cost, present basis was the best, the highest level, being most worth continuing and inheriting, developing and heightening, it yet become in present and in future to be doomed leading breeding way.

### **3. Transforming Gene Breeding Always Not Doing without Sexual Crossing Breeding**

In present stage and from now on long period transformation gene breeding mainly was transforming gene from exotic blood plant or crops. But also gene having not in local crops, only variety of first time successfully introducing gene was true transforming gene variety, after this using sexual crossing breeding method to transform into other good variety, these varieties all really were not true transformation gene variety, Because method and variety resources of breeding all be long sexual crossing breeding. For raising level of transformation gene variety best variety of crops all was selected as acceptor of transforming gene, so best variety to be transforming was always from sexual crossing breeding. Transformation gene breeding had yet fifty years history, also only two genes were successful introduced and relation varieties were planted in big area and emerged negative effect, states prohibiting planting transformation gene grain crops were more and more. Degree of difficulty of transformation gene breeding was very big and needing duration very long, very high cost was hundred, thousand, ten thousand times of sexual crossing breeding, invalid cost was most. These all were reason of transformation gene breeding that cannot always do without sexual crossing breeding. At the least developing states should not do it blindly and positively.

Striving doing well sexual crossing breeding can gave continuously good acceptor for transformation gene breeding or molecule breeding. Because biological molecule breeding only always doing part and cannot do whole plant. Sexual crossing breeding will always be leading position, molecule breeding supplementary.

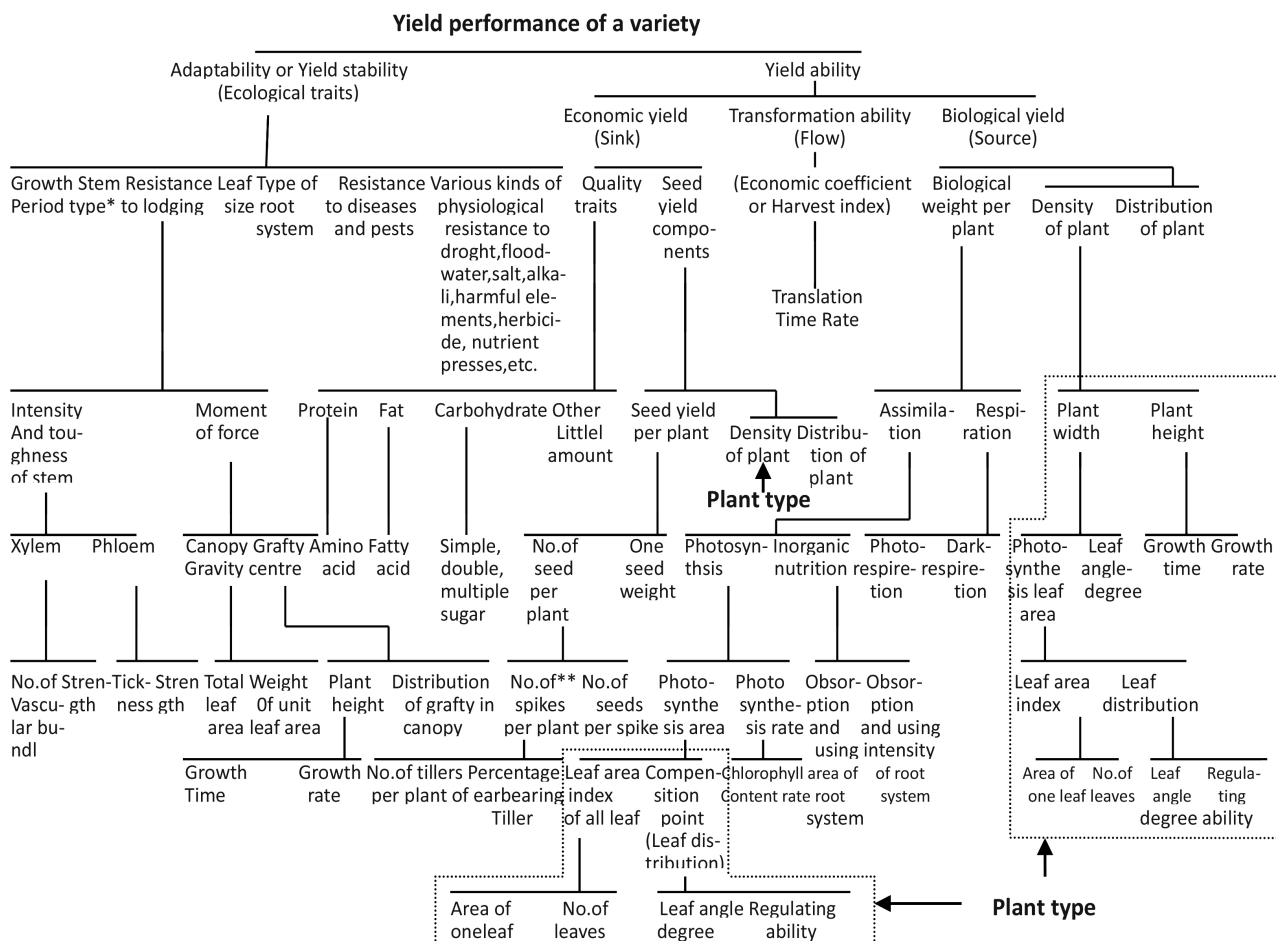
#### **4. Only Rely on Molecule Breeding Operation Not Producing Whole Plant and Not Accomplish Generation Transmission**

On basis of engaging in archaeological studies most early angiosperm originated in front in one or two million and million years, also that was to say angiosperm passed evolution in one-two million and million years to produce modern plant and crop. On basis making textual criticism of fossil man cannot obtained different and continuous plant type of plant evolution in one-two million and million years. Possibly obtained fossil of how mach plant type in different geology ages, man cannot know evolution detail of all of organs, all of matters and its metabolism in such long duration. Therefore only rely on molecule breeding operation cannot produce whole plant and cannot accomplish generation transmission. Only had the aid of sexual crossing, passing sexual crossing to obtained good plant, high quality plant having varied good characters can be obtained and also introducing foreign gene can be transferred.

#### **5. Amazingly High Input of Transformation Gene Breeding Making It Hard to Continue, Especially Difficulty Degree of Basic Research of Molecule Breeding Being Maximum, and the Duration Being Too Long to Lead to the Lose Outweighs the Gain**

In forty years from 1973 to 2012 year, I engaged research of soybean breeding in Jilin Academy of Agricultural Sciences and in Centre of Germplasm Introduction and Crop Breeding of Jilin province. Bred seventy new soybean varieties and used outlay total 245 ten thousand (RMB, yuan), mean cost of each variety was 3.5 ten thousand yuan, but if put into 3500 ten thousand yuan, also hard to do a true transformation gene variety. Huge amount funds of more than 300 million and million yuan were put into doing transformation in initial stage of the century, being several hundred thousand times even million times of putting into sexual crossing breeding, but a transformation gene variety to be planted in big area and having act on self's own expertise property right could not be bred.

In present, maize transformation gene breeding still used sexual crossing breeding method to transform two resistance genes that were cloned, introduced, and expressed by America in China. It shows even considered not problem that yes or not had harmful function to refuse doing grain ration, this also was not simple thing that having money can do. Especially basic research of molecule breeding should completely make clear molecule technique operation of molecule consisting of gene and contacting each other machine and gene expressing to be introduced in plant of more than one hundred and eighty characters including in "Original Theory of Botany (Crop Science)" (Figure 1). These attained completely maturation, true molecule breeding can start. According to support intensity in initial stage in twenty one century consuming cost was



**Figure 1.** Original theory of Botany (Crop Science), Corn and grass family crops. \*The stem type was pod-bearing habit in soybean; \*\*There were petiole (and its length) and nodule, No. of pod per plant, No. of seed per pod in soybean.

30,000 - 50,000 million and million yuan RMB, consuming duration was too long: 50 - 80 years, this also was estimation when basic study had not basis such as lacking molecule operating technique, but research direction to be yet determined. Increase yield effect of transformation gene variety Xianyu 335 was not clear compared with non transformation gene variety Zhengdan 958 in realistic production of corn, but contrary. These were performance of superiority of sexual crossing breeding.

But using scientific crossing breeding way, its breeding efficiency may increase four times more than that of experience, if bred two hundred bester varieties, most input 6000 - 8000 hundred and hundred yuan RMB.

See future from present, gene contribution of seed yield quantity characters was on some locus of a chromosome or on more chromosome and difficult degree of molecule operation was very big, molecule breeding only can introduce simpler resistance genes of exotic plant or crops such as Mensando Company. But changed all of crops and feeding crops into resistance to disease, insects, harmful chemistry matter such as herbicide. Surviving man, animals, plants will be more threatened, who salvaged man? Who salvaged the earth?

## 6. Sexual Crossing Breeding Nimble Using or Introducing New Breeding Material and Parents in Breeding Order

In breeding order of sexual Crossing breeding, new breeding material and good parent material can be nimble and at all times and all places introduced and used, enlarging germplasm source and quickening superior character getting together, raising character level of new variety, quickening breeding order of new variety. Example, first resistance to SMV, higher oil and higher protein content, higher yield, introducing summa soybean germplasm Jilin21new variety, from 1981 year starting cross to 1986 year accomplishing region test and production test, bred time limit only six years. This was most quickly bred variety using sexual crossing breeding way. But order of transformation gene breeding was more complicated and cost more expensive, in any case, cannot do thus quickly. Only when transforming a very simple gene, selecting a most hybrid strain or variety as the acceptor, may do quickly, but also may be very quickly surpassed by new achievement in sexual crossing breeding.

## 7. Founding Original Theory of Botany (Crop Science) Being More Advantageous for Scientific Developing Sexual Crossing Breeding

Original Theory of Botany (Crop Science) was a great theory of most basic and the overall situation of variedly basic school subjects, specialty subjects concerning plant and crop science. It was to be firstly found in the world by Chinese, and also only one original theory in Botany and in crop science. Only it can promote developing these subjects [3], and it had same leading significance for subjects in all of different respect such as biology and molecule biology, genetics and molecule genetics. I hope plant science worker and crop science worker to study, understand, master, apply it, because only Original Theory can develop science and produce big achievement [4]. But also passing selection for vegetative body characters also can obtain better new varieties [5].

Sexual crossing breeding was selected using each plant as main body and main body of Original Theory of Botany (Crop Science) (Figure 1) also was each plant, this same main body showed that this original theory had comprehensive and direct guiding action for sexual crossing breeding. Because Original Theory of Botany (Crop Science) was on basis of plant characteristic level, also decided to use plant character as main body [3] in scientific research.

Contrary, main body of molecule breeding was molecule consisting of gene and contacts among gene molecule, so when Original Theory of botany (Crop Science) of molecule level was maturing, also make clear molecule consisting of genes of the hundred and eighty characters and contact among gene molecule and all can be operated successfully, molecule breeding could be effectively conducted. It shows basis study of molecule breeding, Original Theory Research of molecule level still could not be placed program, even to the extent that to be not think, in this time thinking entering molecule breeding practically had a

most fantastic idea. For this reason present molecule breeding in China yet was in blindly rushing and exploring stage. In future needing more long time than that a number of man blindly optimistic calculated, molecule breeding could become a supplementary breeding way, it was hard leading.

## **8. Sexual Crossing Breeding Certainly Transforming Experience Breeding into Scientific Breeding**

In present sexual crossing breeding is in experience breeding stage. It mainly was dependent on conventional custom and breeder's viewpoints, study on breeding regular pattern fell seriously behind practice and lacked support of bring forth new theories, and moved rapidly fail.

Experience breeding had ten difficult problems:

1) How to form the yield of a crop variety? What was its importance? Why it was most important theory base of crop breeding?

2) How to solve scientifically problem of yield stability of crop variety? What was its' theory base? Which contents Variety Ecology of Crops should include? Why Variety Ecology of Crops con not was early produced?

3) Crossing breeding itself could or could not, should or should not produce its scientific engineering technique system?

4) Lacking high level original materials was a most universal and biggest problem in crop breeding. For example, before soybean of China was best-selling on international market due to excellent quality, after it was pushed out due to big quality falling back. How to solve such problems?

5) How can make additive effects among yield ability characteristic genes to be showed, distinguished and selected?

6) What was source producing hybrid vigor of F1 generation among variety crossing?

7) In breeding of self crossing crop variety and self-crossing line of hybrid vigor utilization crop using F1 generation can or can not test, distinguish, select excellent crossing combinations that had bigger additive effect among seed yield ability genes, worse combinations that had bigger non-additive effect among seed yield genes were sifted out.

8) Which was nature between general blood relationship and characteristic, and which represented even more difference of germplasm (gene)?

9) How can do that important ecological characteristics and yield ability characteristics of material to be selected could all and more quickly reached first-rate or good level? How can do that both germplasm of necessarily excellent character was introduced, and germplasm source was opened up, absolute level of yield ability characteristic of progeny population was also raised?

10) How to reduce population scope, and raised breeding efficiency and lower cost of input?

Setting up Original theory of Botany (crop science), above difficult points could be surmounted and smooth transform quickly experience breeding into

scientific breeding [6].

## 9. Discussion

Six department of Hunan province government jointly undertook “2017·Modern Times Breeding Industry summit and higher research and advanced class of race modern times breeding technique” in Aug. in 2017 (Changsha). A academician of academy of engineering in China did lecture, the title being “Modern crop breeding new technology being direct of seed industry development in China” He said: “Using convention breeding means, breeding of new variety with breaking through nature entered a terrace period, may understand to be breeding achievement increase to be at a standstill period”. Like that what did rely on to break? He said: “new technology of modern crop breeding being direct of seed industry development in China, mainly Included: transformation gene breeding technique, gene editing breeding technology, molecule marking breeding technique, mutation biology breeding technology”. He thought: “If there was not molecule technique, only sexual crossing breeding, breeding level of crops cannot be raised, hybrid strain yet was a breeding to be not future, must resign for molecule breeding”.

Newest example was a head of agricultural department, he was in “The whole nation Hainan seed industry conference in March, 2022.” He said: “Energetically and greatly developing molecule biology technology breeding” “convention crossing breeding like this, keeping it.” Key was that had not enough evidence or theory, or logic reasoning to explain self thesis yes or not right, because this become yet a habit that some leaders also naturally being academic authority.

For things in the world, we know very little, study in all life also to be fixedly only resolved one or two bigger problem. Really and clearly studying was very not easy thins, especially great problem in scientific study, More should listen attentively to some discuss idea, passing fully discuss and repeatedly demonstrating, making a correctly strategic decision, less money spent and do more things, lesson in this side was yet enough more and serious.

In any case, and in a considerably long period, sexual crossing breeding still was leading breeding way, in future it will be leading, I hope ours scientific and technique worker and all of class leaders should have thinking preparing: On the scientific research road, no shortcut to walk, only steady and surely step by step to walk.

## Conflicts of Interest

The author declares no conflicts of interest.

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