



Where Is Way out of Crop Crossing Breeding?

Peizhan Tian

Department of Agronomy, Jilin University, Changchun, China

Email: peizhantian@163.com

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Abstract

Author discussed a series of guiding principles for scientific crossing breeding in future. This paper advanced firstly “Original theory of crop science”, “Net system of genetic character of variety yield performance of crops”. Stressfully expounded its core concept, variety yield performance; basic contradiction between variety adaptability and yield ability; ecology theory of variety suitable-stable ability; theory of yield ability science; plant type trait and plant type theory. A brief introduced this original theory obtained approval, evaluation and great significance in international academic circles. Author was on the basis of original theory in breeding practice bring forth new ideas of breeding and obtained outstanding effect, breeding efficiency increased more than four times. Raised some new concepts concerning genetics and breeding science, for example: each other action between suitability and yield ability (character), closed and open breeding (point out: Open nature of sexual crossing breeding decided it will always have a losing, not foothold and any breeding way all cannot replace it), ecology of crop variety, theoretical genetics and breeding science of crops, etc. In the end, raised transformation present experience breeding into scientific breeding being aimed at difficult problems in experience breeding under leading of original theory and arousing of reformation breeding practice, and objective, assignment, technology key and route, engineer-technology system. Relationship between sexual crossing breeding and transforming gene breeding was also discussed.

Subject Areas

Agricultural Science

Keywords

Crop, Crossing Breeding, Way Out

1. Introduction

Crossing breeding of crops passing one hundred twenty two years from 1900 in

that Mendel's paper concerning Genetics Law was discovered by De Vries, H. and three scholars to 2021y provided basic requirement for grain and meat, egg and mink of the human race. But because it was still in experience breeding stage that mainly was dependent on conventional custom and breeder's viewpoints, study on breeding regular patterns fell seriously behind practice and lacked support to bring forth new theories, and moved rapidly to fail. Blind pessimistic morale was produced in many breeders of crops, and they cried out in alarm: "Crossing Breeding of Crops will leave history stage, and surrendered transformation gene breeding!" Crop Crossing Breeding, what course to follow?

Up to now, breeding of crops was generally recognized as a technological school subject, having no science, but I think that if had technical practice, also had certain theories or science. Passing unremitting efforts in more than thirty years, a theory system was set up that was used to answer "difficult problem in the world", "How to form crop yield?" or that was sought by many researchers "Net system of genetic characteristics of crop yield". It was possible transforming experience breeding into scientific breeding and obvious increasing breeding efficiency.

2. Figure Founding Theory System

Figure 1 [1] [2] was crop population having life and it reflected real situation. It included basic contents of two newly emerging subjects: "Ecology of crop variety" and "Yielding ability science of crop variety", also included function and main metabolic of all organs and organizations, organic connections among all characters or genes were described.

3. Consisting Parts of the Theory System

3.1. Core Concept: Yield Performance of a Variety

Yield performance was obtaining actual yield in experiment, test or production. Its expression methods were kg/hm² or kg/mu (667 m²). Yield performance of a variety was reality of yield of any variety or population under certain conditions. This core concept expressed that objective of the theory system was revealing objective law forming crop yield. Using popular language said: "Crop yield was how to form?" Using scientific terminology said: "Net system of genetic characters forming crop yield. It included structure and each other relationships, mechanisms, etc. of this net system. The theory system may reflect crop yield forming was a vain hope of researchers that had aspiration in agricultural science study, because only such theory or law can be used guiding agricultural technology development and developing sciences.

3.2. Basic Contradiction: Contradiction between Adaptability or Yield Stability and Yielding Ability of Variety

It was abstracted from large number of practice activity in nineteen hundred and seventy four years when first year after I were engaged in soybean breeding

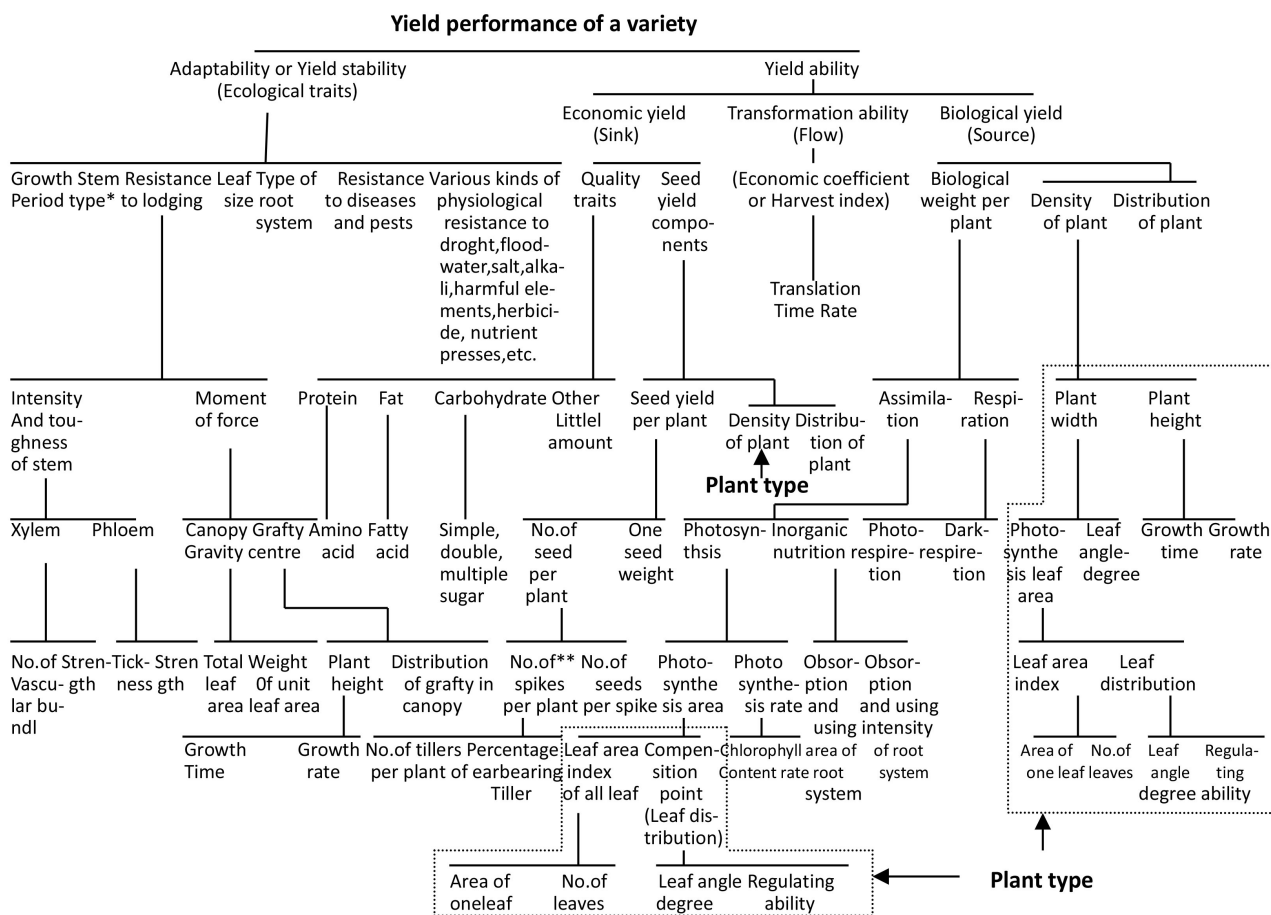
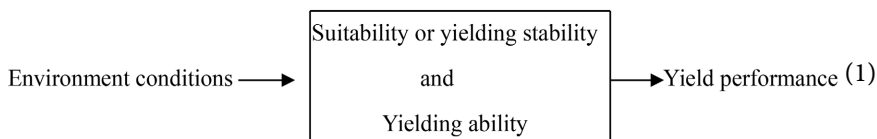


Figure 1. Net system of basic contradiction of variety performance and character composition of corn and grass family crops. *The stem type was pod-bearing habit in soybean. **There were petiole (and its length) and nodule, No. of pod per plant, No. of seed per pod in soybean.

studying work. Yield of a variety obtained under most suitable conditions for this variety was called yielding ability or yield potential. But in production great majority of varieties were under relatively unfavourable conditions, this time varieties had certain suitability for this condition, strong or weak suitability and high or low yielding ability together acted to form yield performance of a variety under this condition (Formula (1)) [3].



This formula was a great development for “Phenotype = Genotype + Environment”, a classical formula that followed for more than one hundred fifty years, revealed composing of internal contradiction of genotype yield performance. Thus bases could be well done for dividing two different natural characteristics, setting up genetic character system that decided and influenced be-

longing to of all of genetic characters of yield performance. This also was main reason for not forming basic principle of crop genetics-breeding in modern times: “lacking analysis of basic contradiction of yield performance”.

This contradiction was very important, may say: “no this abstract, no this theory system”. This basic contradiction is the starting point of the theory system, if there were not the basic contradiction also there was not a theory system. But there were it, followed and concretely studied what were suitable ability traits or yielding ability traits, also relationship among these traits.

Why a variety could increase yield or decrease yield? Increased or decreased yield was introduced by which trait was advantageous or harmful? This was must clear for each scientific worker and technology worker. But if they did not master the theory weapon that could distinguish “yes” or “no”, facing traits or genes of numerous and of all shades, how made a clear distinction between right and wrong? Thus theory weapon was that theory system was sought by us.

Figure 1 had about forty suitable-stable yield traits and sixty yielding ability traits, seed quality traits were spread out after about one hundred yielding ability traits, two type traits together about one hundred and forty. The one hundred and forty traits contacted together passing different routes, no one no-happening linking with others. Thus all traits were determining factors of yield performance, one of them was changed others all happening large or small changing, sometimes very violent. Object of crop breeding was that made all traits achieve new balance on more high energy levels and produce new varieties.

3.3. Theory of Suitable-Stable Yield or Ecology of Variety [4]

All ecology traits had no subordinating traits (**Figure 1**), except growing period and stem type, etc. a small number of traits could influence to display of other ecology traits, great majority of ecology traits were independent (only when using mechanics principle analyzing negative factors of resistance to lodging, several quantity traits were included, but positive factors deciding action: stem intensity and toughness, type of late growing root on stem still were controlled by few genes, belong to quality traits.) These showed that suitable-ecologic traits had more big and more remarkable action for yield performance of variety. Because ecologic conditions deciding to form ecologic traits were nature conditions coming from strong and having force and human action was hard to change, deciding influence of ecologic characters to wave motion of yield performance among different years often having to guide action. Mentioning above showed that selecting firstly suitable ecologic type was important, we should be on the bases of stable yielding, seeking high yield.

Must determining: ecologic trait itself was not yield ability trait, its function was an influence to degree of bringing into play or expressing yield ability of variety. Suitable ecologic type may make yield ability traits to obtain more abun-

dant bringing into play and not suitable ecologic type was contrary, so could not confuse ecologic trait and yield ability trait.

Ecologic trait determined yield stability of variety. Main ecologic traits of grass family crop were growing period, stem type, resistance to lodging, root type, leaf size, resistance to disease and pest, varied physiologic resistance. For soybean and other dicotyledons: growing period, pod-bring habit, resistance to lodging, root type, leaf size, resistance to disease and pests, varied physiologic resistance.

Root type in ecologic traits, and root measure in yield ability traits were two concepts of different nature, the former was difference of “type” or “quality”, the latter was weight or surface area et. Root system of crop was divided into the first time roots, late-growing roots and both all being more developed three types, variety having best resistance to dry possessed developed first time growing roots, after roots growing from embryo axis, stem, tiller node mainly distributed in above twenty to thirty cm of soil, beneficially absorbing water and fertilizer there and having stronger tolerance to water and fertilizer, but not adapting dry area, in general variety with both types root that all were more developed had big planting area.

Researching local varieties and evolving history of extending varieties in varied ecologic areas found that all ecologic traits all had different types, forming these types were in the final analysis determining by type difference of ecologic environment factors. Corresponding relations between each ecologic trait and environment factor were: growing period-light and temperature from the sun, stem type or pod-bring habit-precipitation and its distribution during growing period, resistance to lodging-absolute level and relative difference of light and soil fertility, root type-water content in varied layers of soil, leaf size-absolute level and relative difference of light and fertility, resistance to disease-disease source biologic-ecologic factor, resistance to pest-harmful pest biologic-ecologic factor, varied physiology resistance-relate to drought, floodwater, salt, alkali, harmful elements, herbicide, nutrient press, etc. physical and chemical factors.

If deciding relative factors of ecologic traits could stably and long-term exist, adapting its ecologic type of variety also was stable, for example growing period, stem type, etc., contrary environment factor happening change ifs adaptable type also changed, for example exerting a large number of chemical made soil fertility rapidly increasing to lead to light/fertility ratio largely declining, former variety with bigger leaf and weaker resistance to lodging was replaced by later variety with smaller leaf, stronger stem and resistance to lodging.

Measuring method of adapting-stable yield ability of variety, firstly was on bases of same yield ability, yield performance and suitable ability being consistency principle, second: yield comparison test of allele lines among multiple years, third: yield comparison test of similar allele line from a crosses combination. Concrete norm measuring variety adapting ability was yield stability, except first method, others could not using yield performance to show, because al-

so having action of yield ability in yield performance.

Yield stability was using percentage to show, calculating method was $[(\text{highest yield} - \text{mean yield})/\text{mean yield} + (\text{mean yield} - \text{lowest yield})/\text{mean yield}] \times \%$, the larger result numerical value was, the worse yield stability was. The former numerical value showed a reflection of better years, the latter of worse years. Yield performance was norm using absolute number value showing, yield stability was a relative value (percentage), both could not and were unably combining into one, so called “high and stable index” was not correct.

3.4. Yield Ability Traits and Yield Ability Theory [5]

Yield ability (or yield potential) of variety was that yield performance of a variety under most adaptable environment conditions. Only variedly ecologic conditions all were most adaptable for the variety, ecologic traits were unlikely to become restricting factors of yield ability obtaining full elaboration or expressing and to make varied yield ability traits all fully showing and displaying. Yields of less area high-yielding model in different regions were similar to theirs yield ability of varieties, so-called high-yield breeding should be improving or increasing yield ability breeding, because ecological breeding improving ecologic traits and variety suitable ability also could increase yield performance of a variety.

Yield ability of variety consisted of economic yield (sink), biological yield (source), economic coefficient (flow, also called: transformation ability) three parts, relationship among them was parallel, position was equal, so could not ignore any respect, also so yield ability of varieties may divided high economic yield type, high economic coefficient type, high biological yield type. We all should pay attention to them, they had equal importance, could not only pay attention to economic yield, ignored other two respects and that became restricting factors increasing yield ability of varieties. Breeding of high economic coefficient was an important mark transforming quantity type into quality type breeding and very less subordinating traits became of easily obtaining better effect.

Unite area economic yield (sink) decided by synthetic seed quality, seed weight per plant (or per ear), plan type (deciding planting density). High seed yield varieties may divide more ears (compact planting) type, high yield per plant (or high seed weight per ear) type, middle type, superior quality type, four types (unite seed weight of superior quality type fixed more sun energy). More ear type and improving plant type had a close relationship, big ear type more not closer, middle type gradually clear. They were due to high yield of more ear type variety was close relative with higher population leaf area index, big ear type variety with higher unite leaf photosynthesis efficiency. In above three types of varieties, two extreme types (more ear type and big ear type) were most important, both were unity of opposites, each other were existing and development conditions, only both developed, could drive middle type development. In crop breeding, should advocate compounding three types of crosses: more ear \times more

ear, big ear \times big ear, more ear \times big ear.

Superior quality type breeding belong essentially to special type of high-yielding breeding, was an important mark of yield ability breeding transforming quantity type into quality type. Contradiction fighting for energy distribution between yield and superior quality often was very intense, the more superior quality crop was the more intense was. Correct tactics of superior quality breeding only were on basis of higher superior quality traits level to gradually raised yield. Undue haste for high yield, or using sacrificing one superior trait exchanging for raising other superior trait(s) was short-sighted action, final being defeated, whole level had not been raised. In soybean breeding in China this phenomenon was more prominent, result was that Chinese soybean was pushed out market in the world.

3.5. Plant Type and Its Breeding

3.5.1. Action of Plant Type and Its Importance

Population density was decided by plant type, it not only directly influenced economic yield, but also biological yield, it may pass other ways: photosynthesis—assimilation—biological yield per plant—population biological yield—yield ability—yield performance (**Figure 1**), so it was an important factor influencing yield ability of population (**Figure 1**).

3.5.2. What Were Plant Type Traits of a Variety?

Plant type traits were more. For example, soybean plant type traits had: plant height, petiole length, petiole angle degree, leaf number, area per leaf, leaf angle degree, leaf angle degree regulating ability. Grass crop had: plant height, leaf angle degree, leaf angle degree regulating ability, leaf number, area per leaf (**Figure 1**).

3.5.3. Relationship between Variety Evolutionary and Plant Type

Studies proved that from starting planting variety, variety population of same yield ability had from more ear type to middle type again to big ear type, continuous change, the three types only were indistinct classification. In future along with the increase of yield ability of variety, the three types dividing still were continued, difference range among varieties will gradually enlarge.

In more ear and dense planting type variety breeding contradiction between plant type and dense planting certainly was very prominent. The only way to out was to improve plant type. Objects were reducing disappear light index of crown and increasing leaf area index of population, dry mater yield and economic yield. The key was outstandingly raising leaf area index of population. Most effective method of reducing disappear light index was making leaf change smaller and more vertical, suitably lower plant height. In breeding of big ear type variety with higher photosynthesis efficiency, traits having larger change were thickness of main function leaf, etc. photosynthesis efficiency traits and seed weight per ear, plant type had not marked change. In breeding of middle type variety, both all had change, improvement plant type was gradually obvious.

4. This Theory System Being Great Find in Crop Science Studies

The theory system firstly found and determined net system of genetic trait of crop yield performance, on individual, population, molecule (genes) levels, profound mystery of higher plant life activity and product yield forming were explained. Core concept, basic contradiction and starting point of theory system were raised, forming completely logical relation. It was a great break through for “phenotype = genotype + environment”, classic genetics formula following more than one hundred years, “genotype” was resolved and concrete traits were made sure, doing well being aimed at breeding. Studied and found this net system must use more methods, abstract and generalizing, experiment, test, axiom et. methods, not a single one could be omitted. This net system was gathered together all that total related subject expertise, using scientific expertise synthesizing a live body. Contrary it also will greatly promote development of these relative subjects and more efficacious development of relative using technology sciences and using tech. It will become an important basis of molecule biology and molecule genetics. This theory system was a transition milestone from Mendel’s genetics that could only explain characteristics inheritance into both quality and quantity, transition milestone from small workshop type of breeding into collective engineering of technique system, transition milestone from art into science. It initiated a revolutionary road of breeding of living things.

5. New Enlightenment and Leading Actions of Theory System

5.1. Opening up New Stage of Crop Breeding

5.1.1. Transforming Certainly Experience Breeding into Science Breeding

Crossing breeding of crops passing one hundred twenty two years from 1900 in that Mendel’s paper concerning Genetics Law was discovered by De Vries, H., etc three scholars to 2022 provided basic requirement for grain and meat, egg and milk of the human race. But because it was still in experience breeding stage that mainly was dependent on conventional custom and breeder’s viewpoints, study on breeding regular patterns fell seriously behind practice and lacked support to bring forth new theories, and moved rapidly to fail. Scientific breeding will certainly replace it, and from now a brand-new times of science breeding will be entered.

5.1.2. Scientific Breeding Must Use Science Theory as Leading

Net system of genetic characteristics of yield performance used “yield performance of variety” as core concept, and used its basic contradiction as starting point, respectively expounded “Crop Variety Ecology” “Yield Ability Science of Crop Variety”, two new subjects including more than two hundred genetic traits and relations among traits. Ecologic-suitable ability of variety population as a live body to outside and varied environment factors, corresponding adaptable traits and in forming yield ability including important organs, tissue and these functions, metabolism and relation among them were revealed, and real situation forming crop yield performance was reflected. In order to correctly and

perfectly solved stably yielding (resistance to adversities was stable ability trait), high yielding, superior quality, etc problem giving way and method, thereby determined only this theory could become a leading theory of crop breeding.

5.1.3. This Theory System Was Obtained Approving of Academic Circles

Brief producing process of the theory system: Basic contradiction formula of yield performance was first expressed in “Acta Geneta Sinica” in 1975(4) [3]. After passing more time revising and perfecting, “net system of genetic characteristics of crop yield performance” theory system was published in “Theoretical Genetics and Breeding Science of Crops”, book in 2014 year. English Journal “Open Access Library Journal” published the theory system in 2015 year. American distinguished plant physiology professor Nancy Albert and other four scientists commented and said: “We believe that your contribution to this field is unparalleled and a presentation under any of the sessions will be of great benefit”.¹ In 2018 author was invited as a speaker to attend “2018 Global Summit on Plant Science and Plant Physiology”, Nancy Albert made a charge of summit. In 2000 will convene “Crop Science Conference in the World” in Canada, in 2019 the conference direct immediately send out an invitation to me, but due to epidemic situation the conference convened not. In 2021 paper “Net system of Genetic Character of Yield Performance of Crop and Explanation for It” as a chapter was published in book, “Cutting-edge Research in Agriculture Sciences” by the United Kingdom and India operating “BOOK PUBLISHER INTERNATIONAL” [6].

5.1.4. Experience Breeding Efficiency Lowering

Author summed up a variety of development regular in eighty years from 1940 to 2020 in middle plain area in Jilin Province showing that each big circle was forty years including four small circles, each small circle was ten years. Big circle was on basis of certain plant type improvement and increasing density, each small circle was mainly increasing seed weight per ear. In the past two big circles, corn doing well, but race only first big circle doing and second big circle not. Plant type of soybean was whole not improved in eighty years, only depended on seed weight per plant to increase yield [7]. Variety yield ability of three crops obviously decreased by degrees (Table 1).

Table 1. Crop variety yield ability and its development in eighty years in middle plain area in Jilin province.

Crop	1940 Years (kg/hm ²)	2020 Years (kg/hm ²)	Increase/each year (kg/hm ²)	Total increase (Times)	Plant type improvement situations
Corn	2786	16,000	165	5.74	2
Race	3506	12,000	106	3.42	1
Soybean	2546	4000	18	1.57	0

¹Letter of Invitation of Nancy Albert, Scientific Program Coordinator to Peizhan Tian on Global Summit on Plant Science & Plant Physiology during 12-14, 2018, in Kuala Lumpur, Malaysia.

²Scientific Program of 2018 Global Summit on Plant Science & Plant Physiology.

5.2. Leading with Theory to Bring Forth New Ideas and to Obtained Outstanding Effects

From 1990 years starting author was in soybean breeding on basis of theory system to create breeding and obtained outstanding effects. Below examples could explain that scientific breeding may largely raise breeding level.

5.2.1. Xindadou No 1 Created Highest Yield Record in China and This Record Keeping Eleven Years

It was bred using bumper material (Gongjiao7335) from individual event breeding. In 1999 year, Xindadou No. 1 created 5956 kg/hm² highest yield record that was kept for eleven years.

5.2.2. Jilin No. 34 (90C1810)

Firstly using progeny of spring soybean × summer soybean, again using spring soybean backcross to be bred. In 1999 Jilin No. 34 created 5600 kg/hm², a good result.

Main cause obtaining highest yield in China were 1) improving seed yield ability (sink); 2) method obtaining breeding material of high seed yield was setting up special individual event breeding; 3) improving stem type adapting to high water and fertilizer.

Above two varieties gone through fifteen years from crossing to improved variety, yield ability attained separately 5956 kg/hm² and 5600 kg/hm², increased average per years 130.4 kg/hm² and 107.0 kg/hm², compared with common practice breeding in eighty years, increased 112.4 kg/hm² and 89.0 kg/hm². Breeding efficiency raised 6.2 times and 4.9 times.

5.2.3. New Variety Pingandou 8

Tentative plan of this variety was to reduce leaf size and increase population leaf area index, result was having my wish fulfilled. Pingandou 8 had small linear leaf, biggest leaf on whole plant was 15 cm in length and 4 cm in width, biggest LAI was 6.5 increasing 30% compared with general variety.

Suitable planting density of Pingandou 8 was one hundred thousand plants per hm², right now each plant had 4 - 5 efficacious branches, their lengths were similar compared with main stem. Each hm² efficacious stems (including stem and efficacious branches) were 5.0 - 5.5 hundred thousand. Compared test of main commercial soybean varieties for ten years in Changcun city in Jilin province showed that Pingandou 8 not only had highest mean yield (3189 kg/hm²) among ten years, but also were most stable yielding, change index of yield performance was most small (42.9%), also reflecting good or worse years was similar. When this new variety was trial-planted, living example obtaining more than 4000 kg/hm² was most, highest yield was 4882 kg/hm². In 1998, Liuzhanshan obtained 5114 kg/hm² high-yielding record in 2004 in Shuangyang district in Changchun city.

Compared with parents, almost all of characteristics changed very largely, Genetic regular of characters was completely different with general crossing com-

binations. Due to main selection objective was a small leaf, so parents all had small leaf genes, individual plant with small leaf in F_2 progeny was obtained more easily, also due to yield factor traits. This was first model example obtaining breaking through result passing improvement of plant type traits. Men facing thus improvement effect of reducing leaf blade is difficult to ascertain. It aroused us: not rightly selecting seed yield and rightly selecting other yield ability traits also can obtain good effects, thus opening up a new road in selecting a good variety. Its theory support is “Net system of genetic trait of crop yield”. Because this theory said: “Only improving one or more ecologic-adapting trait, or yield ability trait all can increase yield performance.”

Using fifteen years this variety was bred, its yielding ability increased 1114 kg/hm², mean per year 74.3 kg/hm², raising 4.1 times compared with tradition bred variety, breeding efficiency largely raising.

5.2.4. Fasciated Soybean (in China) Being Using: Pingandou 1020 New Variety

Fasciated soybean in China was a mutant from well-known soybean variety Jilin No. 20 in China in 80 - 90 years in twenty century, a very superior and special germplasm. Its biggest superior points were more nodal points on stem and more leaves, nodes on stem were not alternation and were not regulation, had cyclical, opposite, 2 - 3 bunch, nodes on top of plant were very short and when bloom of top leaf was very small so appearing nest inflorescence. Therefore leaves per plant had forty-five to sixty, the more leaves, the more inflorescence, the more pod. May said that fasciated soybean in China was the best yielding ability germplasm, but its stem was softer and resistance to lodging worse.

Pingandou 1020 was from a crossing combination of fasciated soybean in China as parent. It was having higher height, concentrated pod-bearing on main stem, thin planting type new variety. In Jilin province, its growing period was 135 days, plant height 140 cm, even if planting density one hundred thousand also happening lodging, only obtaining 3750 kg/hm² yield. But on the basis of its ecologic traits, introducing from Changchun city to Cifeng city in Inter Mogolia after its growing period had only 125 days, only depending on irrigation in all life of soybean and sufficient sunshine in local area, plants could obtain fully growing and development and happening not lodging and plant height 125 cm. Test planting obtained high yield in 2007. Planting area ten hm² in 2008, different peasant families all obtained more than 4500 kg/hm² good results, highest 5802 kg/hm² (planting area 1.6 mu, 1 mn = 667 metre²).

5.2.5. Higher Biological Yield Variety Pingandou 5

Pingandou 5 was also from crossing combination of fasciated soybean in China as a parent. It had higher biological yield, increasing 12.6% compared with check variety, leading seed yield increasing 6% - 8%. Appearing more lush vegetation body, more leaves and bigger leaf area index (5.8 - 6.0). These showed that parents having more superior traits were advantageous to selecting more types of

superior varieties or materials. If gathering more superior traits to a material, making parents becoming material outstanding in one important trait and good at several or more traits, certainly may largely raise breeding effects, and produce breeding notion of “firstly setting up more direction individual event breeding of important traits in science breeding plan and selecting parent material of “varied expert in one thing and good at many.”

5.3. Original Theory Bring Forth New Concept of Genetics and Breeding Science

5.3.1. Original Theory of Crop Science

Original theory of crop science was “Net system of genetic traits of crop yield performance.” It firstly had a core concept of clear connotation and distinct extension, then basic contradiction using this core as the starting point, from abstract to concrete, on the basis of principle of identity of logic and history, of steps in the process closely linked and spreading a theory system having closed logic and distinct order (**Figure 1**). Core of original theory of crop science was unity of scientificness and founding nature. Scientific original theory often was developed according to logic of original theory and forefathers’ ideas. Developing any science was all passing original theory to realize, no original theory no science development [8]. Our “Net system of genetic trait of crop variety yield performance” was original theory of crop science. It regards the developing of related school subjects: crop ecology, physiology, genetics, breeding science, crop cultivation science, biology, molecular biology, molecular genetics, molecular breeding science, etc. all having important significance. Under original theory guiding, certainly producing corresponding new concept, new theory and new theory group.

5.3.2. Interaction among Adaptable Ability (Trait) and Yield Ability (Trait)

A most model example was soysbean cultivar, Zaofeng No. 1 with determinate pod-bearing habit under cultivation condition in Gongzhuling in Jilin province was long-term cultured, its adaptable ability gradually rising, yield ability reducing, from **Table 2** may see: increasing change index of rainfall in growing period in later ten years, from 31.9% to 41.6%; but reducing change index of yield performance, from 97.3% to 84.1%. This showed that cultivar suitable-ability with

Table 2. Change of rainfall in growing period in 1954-1973 and interaction among suitable ability and yield ability of Zaofeng No. 1 soybean variety.

Item	Year	Ten-year mean	Highest	Lowest	(Highest – Mean)/ mean %	(Mean – Lowest)/ mean %	Change Index %
Rainfall (mm)	1954-1963	536.8	582.4	410.0	8.5	23.4	31.9
	1964-1973	474.6	531.8	364.8	10.4	31.2	41.6
Yield (kg/hm ²)	1954-1963	2156.3	3217	1116	49.0	48.3	97.3
	1964-1973	2265.9	3056	1149	34.9	49.2	84.1

regard to less rainfall was rising, but yield in best year reducing and yield ability of cultivar reducing. Mean yield in late ten years was increasing, showing suitable ability increasing, outstanding display of increasing suitable ability was transforming model determinant type into semideterminant type (**Figure 2** and **Table 2**).

Evidently, this new concept may use to research changes in crop variety in long-term extending process and found a reason for a long term extending or not.

Interaction between suitable ability traits and yield ability also displayed in backcross breeding or transformation gene breeding transforming resistance to disease or resistance to pests, in no disease year, original susceptibility variety increased yield compared with backcross or transferring gene variety, for example yield of resistance to phytophthora rot disease soybean variety reduced 0.1 - 1.4 bushel/acre compared with former susceptibility variety in no disease in America.

5.3.3. Interaction among Yield Ability Traits

Eichelberger etc (1989) bred corn line having high nitrate reductase and adapting to the lower nitrogen condition and corn line having lower nitrate reductase and adapting to high nitrogen all reduced yield under the general condition. In recent years, bred transformation gene millet serious reducing yield compared with original variety and had to suggest planting in dry region and poor soil region. All varieties of transformation gene of improvement fatty acid composition all reduce yield. Transformation gene breeding of yield ability trait had more difficult compared with that of suitable ability trait.



Figure 2. Changes of pod-bearing habit of Zaofeng 1, soybean variety planting in Gongzhuling in two ten years. Left: 1954, typicaldeterminant; Right: 1973, semideterminant.

5.3.4. Closed and Open Breeding

Regardless of which interaction among genes, its common ground was that under the genotype background energy absorbing by the whole acceptor gene system had not changed. If changing a trait and transforming a corresponding gene, in expressing process energy in acceptor was consumed, reducing energy in order to form yield and leading increase yield. This was result closely moving of this kind of gene system. Breeding using this way was called closed breeding. Following situations belong to this breeding: 1) Natural mutation of gene in a variety; 2) Selection of isolate or 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) Astronaut breeding (space breeding) in general situation; 7) DNA fragments import in general situation.

Except above breeding ways sexual crossing breeding, breeding of heterosis using, recurrent selection breeding belong to open breeding, its distinguishing feature was whole gene system participating all in recombination, can produce linkage improvement of voluntary selection trait and non-voluntary selection trait, final was due to this improvement, plant absorbed and used more energy from environmental conditions, thus assuring improvement of adaptable-ecological trait and yield ability trait, increasing yield or improving quality.

Open nature of sexual crossing breeding decided it will always have a losing not foothold and any breeding way all cannot replace it.

Closed breeding and open breeding were of most intrinsic generalization for varied breeding ways, was theory basis correctly evaluating varied breeding methods and ways. It made people abandon the traditional concept that only had variation and also emergence of new variety, also made people refute mythology on basis of theory that depending on closed breeding could obtain higher yield variety. Thus knowledge can produce only on the basis of above original theory, thereby resolving disputing problem in more than one hundred years, for example, nonprofessional scientist evaluated non-objectively for mutation breeding.

5.3.5. Ecology of Crop Variety

Ecology of crop variety was studying science of relations between crop variety and ecological environments, a newest school subject, an applying basis subject. Its concrete research contents: forming, action, function, significance in crop production, studying method of ecological trait and its type of crop variety, was theory bases resolving adaptability problem of crop variety with regard to environment. Resolved variety yield stability problem in production practice, but in the final analysis was solving variety more reasonably, abundantly, effectively using nature environment, etc. resources, obtaining better economic effect problem.

“Ecology of crop variety” was a composition part of “Net system of genetic character of crop yield performance” so no study of basis contradiction of yield performance, no this original theory, no “Ecology of crop variety”.

Main differences between “Ecology of crop variety” and treatise of other related ecological breeding were: the former was firstly making clearing on the basis of core theory, basic contradiction of yield performance, to produce, ecologic theory only being a part of whole theory. Ecologic breeders easily produced recognizable limitations, and distinguishing not trait of two types different nature, easily happening unrealistically and including belong not to ecologic trait, all of trait to be involved called all as ecologic trait or “accompany trait”, so much so that resistance to lodging, growing period, resistance to disease, etc. important ecologic trait and important yield ability also were called as “accompany trait” [9]. Clearly belong to yield ability trait for example seed size, seed quality, plant type to be called as ecological trait by some ecologic breeder or researcher, this was a wrong overflow ecological concept.

5.3.6. Should Have Concept of “High Yielding Ecologic-Type” “High Yielding Ecologic-Breeding”, Yes or Not?

Ecologic breeding and yield ability breeding were confused by a lot of crop breeder, a statement was “high yield ecologic type” or “high yield ecology breeding”. Scholar keeping this statement recognized that high yielding variety all passed certain environment to realize high yielding, adapting different ecology conditions of varied high yield ecology type, and forming different shape and characteristic”. In practice, suiting ecologic type variety in various places firstly was growing period, stem type, root type, resistance to lodging, resistance to disease, etc. type of ecologic trait being suitable, making yield ability traits fully bring into play and expressing. Yield ability characters including all traits of sink, source, flow on different layers had no fixed ecologic model. Same varieties of yield ability may have a lot of combination patterns of yield ability trait. Ecological type suiting ecologic conditions strictly had only one combination pattern. So in regard to high yield variety in different areas also had respectively suitable ecologic type of certain difference, significance and function of ecologic type were having best stable yield ability, it was not direct relation with yield ability, but exist not “high yield ecologic-type” or “high yield ability trait ecologic-type”.

5.3.7. Seed Quality Traits Were Ecologic Traits? Yes or Not?

Seed quality characters belong to yield ability trait, not ecological character. Reasons: 1) Ecological traits were genetic traits forming under long term action of certain ecologic factors, production of seed quality trait had not inevitable relation with certain ecologic condition factors. 2) Type of ecologic trait directly influenced to yield stability, suitable variety had stable yield and not-suitable no stable yield, without the slightest difference, seed quality trait had not nature. 3) Trait happening to change under different conditions was all called ecologic character, this recognition confused two types of traits of different nature of ecologic trait and yield ability trait, because “variety having different ecologic trait required planting under different condition” this correct theorem, extended “every under different condition trait happening variation called all as ecologic trait”

this converse theorem was wrong, if this correct, almost all of yield ability traits all become ecologic traits, no having yield ability trait. 4) Mean of a quality trait in certain area may be higher, but comparison among every individual variety was not such, ecologic trait to stable yield ability influence was having being good, no being worse, must be comparison among individual variety, cannot using mean of more varieties.

5.3.8. Theoretical Genetics and Breeding Science of Crops

On the basis of net system of genetic trait of yield performance of crops, original theory of crops, analyzed and studied composition relation and genetic relation among varied traits and on the basis of these laid down new science breeding plan and concrete technology and study method of germplasm resource of relation to breeding, these were study contents of theoretical genetics and breeding science of crops. It was essentially different from experience breeding of crops. Experience breeding was on basis of experience, point and traditional habit of breeder to lay down breeding plan and concrete technology. Scientific breeding was contrary, it was under leading of original and theoretical genetics and breeding science of crops laid down breeding plan and technology, more according with science development regular and effective. It was a high degree developing stage, producing break through nature achievement was big probability things.

On basis of above-mentioned advanced objective and main assignment of scientific breeding:

Using basic contradiction between ecological adaptation ability (yield stability) and yielding ability of crop variety was used as a start point to set up genetic characteristic net system, it was also called Basic Theory System of Scientific Breeding of Crops. On the bases of it, to set up Modern Breeding Technique System that getting together quickening excellent characteristics was used as nucleus, closed combination of individual event breeding with synthesis breeding of important characteristics was as technology route, unified variety resource evaluation and Preparing Breeding were as bases.

Change passive and non-determinacy selection into voluntary and determinacy. Introducing and utilizing excellent characteristic were as most important ways of improving and extending genetic bases. Studies on Preparing Breeding and unified variety resource evaluation should be strengthened feasibly, their objective was providing parent materiel for all of individual breeding that combination dispose of main characteristics all attained superior \times superior standard on the basis of needs of synthetic breeding objective on this base concentration selecting accurately for important characteristics was conducted and blindness was greatly reduced.

Determining method of additive effects among important yield ability characteristic genes to be showed, distinguished and selected; Through test for F1 generation, excellent combination having bigger additive effects of seed yield will be distinguished and keep back, worse combination having bigger non-additive effects will be sifted out; Yield of self-line of hybrid vigor crop and new variety of

self-crossing crop was more quickly and continuously raised.

Source producing hybrid vigor was studied and determined, contribution function of important ecology characteristics for hybrid vigor or non-addition effect was fully brought into play, Opening up and setting up new model of high hybrid vigor, using new method to dispose and select crossbreed and raising hybrid vigor and combing ability.

5.3.9. Two Inferences of Basic Contradiction Formula (1) Yield Performance of Crops

Inference 1: comparison among varieties, if adaptability is the same, yield performance is higher, yield ability also higher. Inference 2: comparison among varieties, if yield ability is the same, yield performance is higher, adaptability also higher.

These two inferences may use leading varied variety of identify test, comparison test, region test, production test, etc. At present, these tests are only on the basis of growing period of variety of divided test group, but except growing period there were still some important ecologic: stem type, resistance to lodging, leaf size, root type, resistance to disease and pests, etc. Should on the basis of climate, soil, etc. conditions in certain ecologic area concretely provided special type feature, every unit providing variety also should possess variety of same or similar ecologic traits, keeping test materials had all same suitability, thus with regard to varied breeding unit being fair. Besides also according with theory principle on the basis of good adaptability, again comparing and selecting high yield ability.

5.3.10. Scientific Classification of Variety and Germplasm Resource

Along with development and accumulation of varied breeding units varieties and germplasm resources were more and more, using well were wealth not burden, very much of units only using very less resource, due to attaching no importance to this basic work, lost, mixed, having not name were not less. People of breeding circle said that an important reason was not enough for excavating and using superior germplasm resource, also having certain truth. But due to undue haste for success, paying no attention to basic work being as before may be a more important cause. Certainly also having reason of policy and management, and cause of lower systematic nature of science and technology personnel. Above original theory was a can largely raise crop breeding level theory, it same can lead study of variety of resources. Firstly set up variety of resource classification methods fitting science breeding, then on the basis of this classification steady and sure do well unified identification test of variety of resources, accumulating and science analysis data, registering, etc. On the basis of science breeding to determining investigation and study project, important ecologic trait, yield ability trait, specially set up a project of individual event breeding all were focal point recording [1].

5.4. Using Original Theory as Leading Reforming Breeding Technology System, Transformation into Science Breeding

If careful think may find: big nature gave man very wonder and ingenious ar-

rangement, make people more having confidence setting up this new theory, for example: 1) Adaptability trait and yield ability trait were divided into two types of traits of different nature, it all have itself place, duty and function. 2) Genetic feature of two type trait have basic difference, since having quality trait, also opposite quantity trait. 3) Gene controlling ecologic trait was less and action of individual gene was big, gene controlling yield ability trait was more, but action of individual gene was small. 4) Big nature actually special arranging two core trait to control heterosis, this was confirmed in soybean.

Figure 3 was a newly set up scientific breeding technology system, focal point was doing well varied individual event breeding, then conducted synthesis. Analysis and synthesis were objective laws of science development, must be put into practice. But basis work was a variety of resource identifying and preparing breeding, their objective was providing parent materiel for all individual breeding that combination dispose of main characteristics all attained superior × superior standard on the basis of needs of synthetic breeding objective.

Leading think setting up breeding technology system Scientific breeding technology system set up using original theory as leading, using quickening

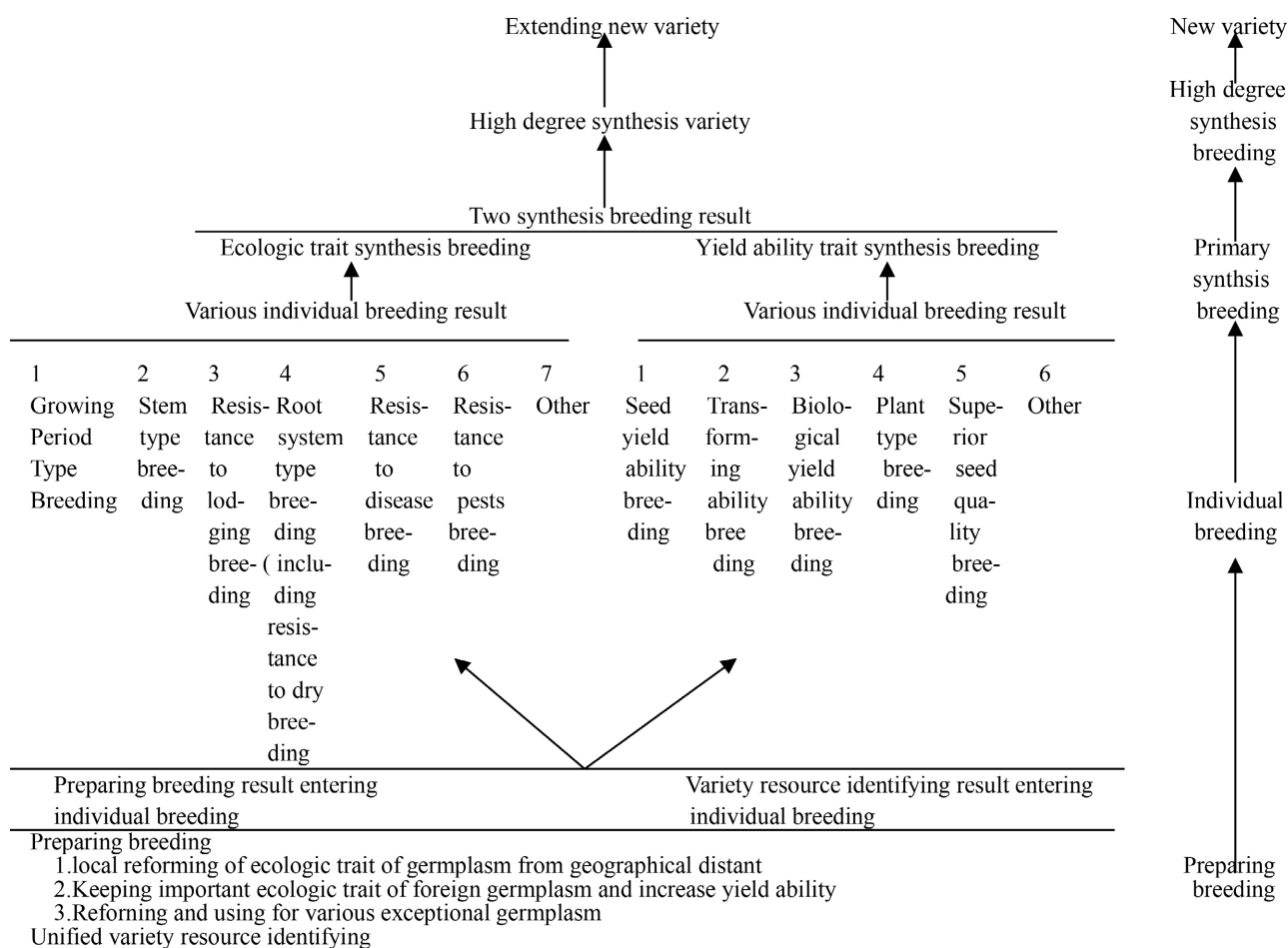


Figure 3. Scientific breeding engineering technology system using individual event breeding as assuring and close combination with synthesis breeding.

superior trait getting together as core, using individual event breeding of important trait as assuring and closed combination with synthesis breeding as technology route, using unified variety resource and preparing breeding as basis (Figure 3). **Two technology keys:** Firstly was individual event breeding going ahead, individual event and closed combination with synthesis breeding. Secondly parents of individual event breeding should be “expert in one thing and good at many” (Table 3).

Technology methods of quickening superior trait getting together: 1) Continuing raising increase yield trait (sink) level. 2) Breeding and selection of increase new raising yield trait (Table 3, Figure 3). 3) Setting up individual event breeding, two parents combination should achieve superior × superior of important traits, three main traits all should have strict demand. 4) When compound

Table 3. Objective of various individual event breeding in science breeding.

Type	Individual event breeding name	First main character	Second main character	Third main character
Ecologic Trait breeding	1) Growing period and its forming a complete set	Growing period	Seed yield ability	Stem type or resistance to lodging or other ecologic character
	2) Stem type or pod-bearing habit and forming complete set	Stem type or pod-bearing habit	Seed yield ability	Growing period or other Important ecologic trait
	3) Resistance to lodging and forming complete set	Resistance to lodging	Seed yield ability	Same above
	4) Root type and resistance to dry and forming complete set	Resistance to dry type is primary root type, broad planting variety primary secondary root system all developed	Seed yield ability	Same above
	5) Resistabce to disease and forming complete set of types	Resistance to disease	Seed yield ability	Same above
	6) Resistance to pests and forming complete set	Resistance to pests	Seed yield ability	Same above
Yield ability trait breeding	1) Seed yield ability (sink) and firming complete set big, middle more ear	Seed yield ability	Quality lowing is not a mean of extending variety (P40.5%, F20.5%)	Same above
	2) Transforming ability breeding	Economic coefficient, harvest index, seed stem ratio	Seed yield ability	Same above
	3) Biological yield breeding	Biggest aerial part dry matter weight in seed growing stage	Seed yield ability	Same above
	4) Plant type breeding	Special plant types or factors	Seed yield ability	
	5) Seed quality breeding (for example soybean)	Protein 41.5% fat > 21.5%	Seed yield ability or important ecological traits	Seed yield ability or important ecologic traits

“Leaf size” breeding was included in plant type breeding, yield ability breeding should use guiding growing period and stem type as promising.

crossing combination, keeping less or no difference of important ecologic traits (specially growing period and stem type), yield ability must accomplish superior \times superior, thus yield trait differences among progeny plant were mainly produced by addition effect of quantitative characters, and reducing interference of non-addition effect of ecologic characters, phenotype and genotype of yield characters were more similar, frequency of superior gene higher. 5) Crossing and selecting method of two extreme types: for example big ear and more ear were two extreme types, they supplement each other and each other exist condition. In breeding at the same time compound big ear \times big ear, more ear \times more ear, more ear \times big ear three type crossing, not only can raise frequency of superior genes but also drive development of middle type.

6. Crossing Breeding and Transformation Gene Breeding

6.1. Concerning Nature of Breeding

Sexual crossing breeding belongs to opening breeding, transformation gene breeding closed breeding. This was most intrinsic difference between two breeding, this theory also enlightened under original theory, "Net system of genetic trait of yield performance of a variety" and produced. Concept of open breeding and closed breeding also were most intrinsic concept by nature (see 4.3.4). Biggest defect of transformation gene breeding was not increasing yield ability of a variety, because transforming gene absorbed energy of acceptor to express itself, reducing energy supplying for yield ability trait, closed acceptor cannot increase itself energy. Transforming gene express required energy the more inducing yield.

Sexual crossing breeding belong to open breeding, its distinguishing feature was whole gene system participating all in recombination, can produce linkage improvement of voluntary selection trait and non-voluntary selection trait, final was due to this improvement, plant absorbed and used more energy from environment conditions, thus assuring improvement of adaptable-ecological trait and yield ability trait, increasing yield or improving quality.

Open nature of sexual crossing breeding decided it will always have a losing, no foothold and any breeding way all cannot replace it.

6.2. Transforming Gene Breeding Always Leaving Not Sexual Crossing Breeding

At present stage, transforming gene breeding mainly transformed distant plant or crop gene into big area planting crops, thus gene being transforming crop was not having. But only first being successfully transforming gene variety was true, after this using sexual crossing method transforming into other superior varieties, were not true, because varieties source and breeding method all were sexual crossings, new varieties being transformed always were from sexual crossing breeding. Transformation gene breeding already had close to fifty years of history, only two genes were successfully transformed and large area planting, also

appeared negative effects, the more states the more banning transforming gene grain crops. But here only saying technology, technology difficult degree of transforming gene breeding was very big and big, very long circle, very high cost and being several ten to hundred times of cost of crossing breeding and most invalid cost, these were cause of its always leaving not crossing breeding. At the least developing states should not blindly and positively do transforming gene breeding.

6.3. Sexual Crossing Breeding Must Transforming Experience Breeding Into Scientific Breeding, but Cannot Change Its Guiding Position

Present sexual crossing breeding has 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 was not 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 the most universal and biggest problem in crop breeding. For example, before soybean of China was best-selling on international market due to excellent quality, 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 be shown, 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 important ecological characteristics and yield ability characteristics of material be selected all and more quickly reach 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?

This article writing just right for solving above difficult problems in experience breeding, after learning and understanding step by step to do.

Doing well sexual crossing breeding can continually give superior acceptor for transformation gene breeding or molecule breeding, because the latter(two breeding) only always doing spare parts, cannot do whole plant, sexual crossing breeding will always be guiding position, feeling free to have itself problem and shortcoming.

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Conflicts of Interest

The author declares no conflicts of interest.

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