

Heredity and Breeding of Resistance to Sclerotiniase in Sunflower

Huang Xu Tang

Economic Crop Research Institute of Heilongjiang
Academy of Agricultural Sciences

Abstract:

This article has synthesized research results about heredity and breeding of resistance to sclerotiniase in sunflower and author's working experience in above research institute, and has discussed parameters of combining ability and heritability of resistance to sclerotiniase, as well as the way and method breeding of resistance to sclerotiniase. Selection of general combining ability of resistance to sclerotiniase is effective and it plays an important role in parents selection of disease-resistant breeding. The heritability of resistance to sclerotiniase is more powerful in sunflower. The breeding work of resistance to sclerotiniase shall begin at early generation through pedigree, rotational crossing and bulk selection procedure to insist on principles of characterization and selection from generation to generation

Key Words: Sunflower, Sclerotiniase, Resistant Breeding, Combining Ability

Introduction:

Sclerotiniase is one of major diseases of sunflower happened distributively in all countries of the world. It has heavily affected on growth of sunflower, so is it in our country. There happened distributively in sunflower areas of Northeast of China, Shansi Province and the Nei Monggol Autonomous Region, especially it is heavily in Heilongjiang Province. According to statistical data that morbidity in general fields from 1985 to 1987 has come up to 30%-60%, and incidence of the disease in serious fields has come up to more than 90%. In 1987,

there appeared sclerotiniase in Baicheng Areas of Jilin Province, the output of sunflower has decreased by 34.9%-58.2%. It is leading way for resistance to sclerotiniase breeding to relieve harm of sclerotiniase, so it has been attached great importance to genetic regularity of resistance and work of resistance to sclerotiniase breeding in many countries and areas. At present, in the course of high-yield and high-oil breeding, breeding departments have taken resistance to sclerotiniase as important breeding goal. In 1983, our institute has start to take genetic regularity of resistance to sclerotiniase and work of resistance to sclerotiniase breeding as important study projects. Now, it has made a breakthrough progress.

Materials and Methods:

1. Using sterility line of anti-3A, 74102-4A, 84102-6A and restored line of R4, R5, R6 and R7 to have incomplete double-row hybridization so as to acquire 12 hybrids (F1). Using random block designing experiment to repeat for three times. Using natural conditions of serious illness regions in Heilongjiang Province to investigate non-morbidity after maturation, so investigative result shall be substituted with arc-sine of square root, to have analyses for combining ability.

2. From 1986 to 1988, I used 13 materials of hybrids and check variety tested in National Sunflower Combined Regional Test to calculate hereditary parameters in similar way, such as heritability genetics, and phenotype amoeboid factors.

3. According to genetic mechanism of resistance to sclerotiniase and my working experience, we have already used breeding materials to study selection of hybrids of resistance to sclerotiniase from the beginning of studying types of sclerotiniase and inoculation method of resistance to sclerotiniase.

Results and Discussion:

1. Analyses of Combining Ability:

Variance analysis: Differences among blocks are not obvious ($F=1.15$), differences among hybrids are extremely remarkable ($F=10.05$). Effect of general combining ability of P1 (sterility lines) has come up to extremely remarkable level (Model I $F=46.57$; Model II $F=34.08$); effect of general combining ability of P2 (restored lines) has come up to remarkable level (Model I $F=3.08$, Model II $F=2.27$). Effect of special combining ability between P1 P2 hasn't achieved remarkable level ($F=1.37$), it is seen from above that it may be calculated general combining ability effect and its relative effect (seen table 1). It is estimated that variance of general combining ability for population is 97%, variance of special combining ability is 3%. It is seen that it is very important for general combining ability of resistance to sclerotinose in experimental population. additive effect should occupy leading position. It is effective to increase resistance to sclerotinose for sunflower and select high general combining ability materials for hybrid parentage. however, special combining ability, that is, non-additive effect is secondary.

Table 1. Relative Effect of General Combining Ability and Special Combining Ability

P1 \ P2	R4	R5	R6	R7	$\hat{g}(\%)$
	$\hat{s}(\%)$				
Anti 3A	8.88	-7.83	11.91	5.38	-23.41
74102-4A	18.34	-0.53	-4.32	-13.57	-22.45
84102-6A	-9.51	8.31	-7.01	12.24	45.88
$\hat{g}(\%)$	-14.43	-1.80	14.21	2.04	

2. Hereditary Ability Analysis:

By calculation, seen table 2 of annual genetic factors. It is seen from table 2 that general hereditary ability of resistance to sclerotiniöse properties are higher, its average value in three years is 77.17%, however, it has changed greatly in different years, this shows that hereditary ability of resistance to sclerotiniöse for sunflower is more powerful, may be selected in early generation and its hereditary amoeboid factors are much higher, its average value in three years is 34.43%, this shows that breeds of sunflower have larger gene type difference of resistance to sclerotiniöse, of which selection is effective and differences of amoeboid factors among years are much larger, it shows that there are many elements of anti-property which affected. There is less changes for hereditary and phenotype amoeboid factors in similar year, and it is also thought that heredity of resistance to sclerotiniöse is principal, but environmental influence is secondary.

Table 2. Hereditary Factors Value % in Different Years

Parameter	2 h B	X	6 g	CVg	6 p	CVp
Particular years						
1986	85.43	59.59	20.10	33.72	20.63	34.62
1987	66.51	29.96	15.47	51.64	16.54	55.22
1988	79.56	71.30	12.78	13.28	13.23	18.62
Average Value	77.17	53.62	16.12	16.82	16.82	36.15

3. Breeding of Resistance to Sclerotiniöse

(1) Types and Breeding of Sunflower's Sclerotiniöse

On the shape of intrusion and infection of causative agent, sclerotiniöse may be divided into hyphae and ascospore type. According

to genetic position and symptom, sclerotiniosis may be divided into: root rot, stem rot, leaf blight and disk rot, of which root rot is sclerotia and hypha in soils and seeds intrusion and infection; stem rot, leaf blight and disk rot are ascospores in their early intrusion and infection. In different ecological conditions, intrusion and infection shape of causative agent has obvious difference. Mostly of serious sclerotiniosis areas of sunflower in our country, took ascospores intrusion and infection as key link due to much rain in later stage (from July to August) of growth for sunflower partly of resistance of sunflower on the ground that leaves are stronger than stem and stem is stronger than flower, so disk rot sclerotiniosis is the most important, and next are root rot type and stem rot type. Leaf blight type is seldom happened, only on the partly leaves. In China, breeding of resistance to sclerotiniosis has taken breeding and selection of disk rot of resistance as key link, part-time root rot.

(2) Inoculation Method of Resistance to Disk-Rot Type Sclerotiniosis

As appearance of sclerotiniosis of sunflower has a close relation with climatic conditions, so exact and effective characterization is the key link of raising selective efficiency. From 1989 to 1990, I compared five Inoculation methods and analysed whether the result of inoculation could reflect natural practice, it showed that fresh inoculation method of fresh hypha toothpick* can reflect resistant property of materials itself, it is a kind of simple and effective inoculation method of sclerotiniosis for sunflower. In the same time, we have used this method to have inoculation for 198 materials, morbidity of mostly materials were reached over 90%. Resistant difference among varieties displayed expanded speed of diseases' spots to create difference of index of disease state and loss rate. According to

* seen <Oil Crops of China> No.1, 1991, "Inoculation Method of Sclerotiniosis in Sunflower"

expertise that it was determined 84102-6B and 86103 B were B-Lines of resistance to sclerotiniase and 84102-6AXR5 (LongkuiZa No.1) was hybrid of medium resistance to sclerotiniase. Anti- 3B,74102-4B, which most of materials were high susceptible or susceptible materials.

(3) Way and Methods of Sunflower Breeding of Resistance to Sclerotiniase:

At present, through identification for resistance germplasm, (especially for wild resources,) resistance germplasm shall be led to resistant gene as hybrid. In early generation, methods were used through pedigree, rotational crossing and bulk selection procedure to select excellent and stable strain or B-line and R-line of resistance to diseases and select varieties of resistance to diseases or hybrid of resistance to disease.

- As sclerotiniase belongs to quantity property, most of which are controlled by gene, and additive effect occupies dominant position, so we must begin at early generation through pedigree, rotational crossing and bulk selection procedure and insist on principles of characterization and selection generation and generation. For example, breeding and selection of 84102-8A of sterility line of resistance to sclerotiniase developed in our institute is selfing, backcross and characterization course. Crossing 74102-4B with a material with resistant gene, of which whole breeding and selection has been completed in disease garden at the beginning of F₁, which combined intrusion and infection with inoculation to identify 84102-6 of sterility line sclerotiniase between 1.25 and 25 to achieve resistant disease level. 84102-A6 of resistance to sclerotiniase examined by combining ability has higher general combining ability, that 84102-6AXR5 of hybrid of R5 in restored line is hybrid of medium resistance to sclerotiniase. In similar breeding method, we have also completed LongkuiZa No.2 of hybrid of medium-resistance to sclerotiniase that resistance to sclerotiniase is stronger than above LongkuiZa No. 1 of hybrid.