A New Cultivation Technique of Cangmai 6005 for High Yield in Cangzhou Dry-alkali Land

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Abstract Cangmai 6005 is a national wheat variety approved by Cangzhou Academy of Agriculture and Forestry Sciences, which has the characteristics of drought resistance, salt tolerance, high yield and stable yield. According to the characteristics of dry-alkali land in Cangzhou City and the variety characteristics, the new cultivation technique was completed.

Key words Cangmai 6005, Dry-alkali land, New technique

1 Introduction
Cangmai 6005 (1) was bred by Crop Breeding Center of Cangzhou Academy of Agriculture and Forestry Sciences, adopting stress-resistance breeding technique and using Linfen 6154 as female parent and 321-4-6 as male parent for sexual hybridization (approval number of GuoShenMai 2010013; JiShenMai 2012007) (2-4). This variety has the characteristics of drought-resistance, saline-alkali tolerance, high and stable yield. The high-yield cultivation technique of wheat in the dry-alkali land of Cangzhou is applicable to the wheat area without irrigating conditions, which can reduce the economic losses caused by natural disasters and realize the high and stable yield of wheat in large area. In order to study the high-yield cultivation techniques of Cangmai 6005 in the dry-alkali land of Cangzhou, it was experimented and popularized on a large scale in Team 9 of Huanghua Zhongjie Farm from 2012 to 2014, a set of high-yield cultivation techniques were formed, and good results were obtained.

2 Characteristics of varieties
2.1 Botanical and biological characteristics The variety had semi-winterness characteristics and was mature 2 d later than the control Jinnai 47. The seedlings were creeping, with robust growth, the tillering ability was strong, and the percentage of ear-bearing tiller was high. The plant height was about 80 cm, the spike layer was neat, and the spike was fusiform. The white grain was full and the wheat husk was white. In the two-year regional experiment, the average number of spikes was 6.285 million/ha, the number of grains per spike was 28.7, the 1 000-grain weight was 38.8 g, and the bulk density was 777.9 g/L. The lodging resistance was strong, and Cangmai 6001 had the same cold resistance as Cangmai 6001.

2.2 Yield performance In the regional variety experiment in the Huanghuai winter wheat region from 2007 to 2008, the average yield was 4 512.0 kg/ha, which was 6.3% higher than that of the control Jinmai 47. In the test from 2008 to 2009, the average yield was 3 781.5 kg/ha, which was 5.5% higher than that of the control Jinmai 47. In the production experiment from 2009 to 2010, the average yield was 3 925.5 kg/ha, which was 2.1% higher than that of the control Jinmai 47 (5).

In the regional experiment in the Heilonggang valley from 2009 to 2011, the average yield was 5 424.05 kg/ha, which was 7.64% higher than that of the control Jinnai 32 and 5.49% higher than that of the control Cangmai 6001. In the production experiment from 2010 to 2011, the average yield was 5 740.95 kg/ha, which was 8.41% higher than that of the control Jinnai 32. Compared with the control Cangmai 6001, the yield increased by 4.48%, ranking first among the three tested varieties.

2.3 Identification of drought resistance According to the drought resistance identification by Institute of Dry Farming, Hebei Academy of Agriculture and Forestry Sciences, the drought resistance index of artificially simulated drought shed in 2009 - 2010 was 1.119, the drought resistance index of natural drought environment in field was 1.158, the average drought resistance index was 1.139, indicating that the drought resistance was strong (grade 2). From 2010 to 2011, the drought resistance index of artificially simulated drought shed was 1.203, the drought resistance index of natural drought environment in field was 1.121, the average drought resistance index was 1.162, indicating that the drought resistance was strong (grade 2).

2.4 Quality determination In 2011, through the determination by Grain Quality Monitoring and Testing Center of the Ministry of Agriculture (Harbin), the content of grain crude protein (dry basis) was 14.63%, the content of wet gluten was 34.7%, the sedimentation value was 27.6 mL, the water absorption rate was 58.0%, the formation time was 2.7 min, the stabilization time was 2.6 min, the maximum resistance was 154 E. U., the extensibility was 166 mm, and the stretching area was 38 cm².

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3 Experiment and demonstration of Cangmai 6005

In Team 9 of Huanghua Zhongjie Farm, the plots were contiguous, and the soil was barren and arid. It is the representative of winter wheat area in the low plain of the Bohai-Rim. In 2015 and 2016, Cangmai 6005 was planted in this area with high-yield cultivation techniques in dry-alkali land. The demonstration area was 2 ha. The three yield elements and the yield can be shown in Table 1.

Table 1 Three yield elements and yield of Cangmai 6005

<table>
<thead>
<tr>
<th>Year</th>
<th>The number of spikes //10^4/ha</th>
<th>The number of grains per spike</th>
<th>1 000-grain weight //g</th>
<th>yield kg/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>612.35</td>
<td>27.20</td>
<td>39.2</td>
<td>5 549.75</td>
</tr>
<tr>
<td>2016</td>
<td>623.14</td>
<td>28.30</td>
<td>38.8</td>
<td>5 815.98</td>
</tr>
<tr>
<td>Total</td>
<td>617.75</td>
<td>27.75</td>
<td>39.0</td>
<td>5 682.87</td>
</tr>
</tbody>
</table>

4 High-yield cultivation techniques in dry-alkali land of Cangzhou

4.1 Soil moisture storage and conservation

4.1.1 Deep tillage and moisture storage. The dry-alkali land planted once a year is characterized by deep turning before lodging, with need of harrowing rather than tillage, so that the soil forms a structure of inner and outer covering, which can not only receive rain water, but also prevent surface runoff, thus creating a fertile and breathable soil environment for wheat sowing.

In the dry-alkali land with double cropping, deep plowing can be carried out before sowing of the previous crop, and the suitable depth of plowing is 20 – 22 cm. If conditions permit, it can be deepened to 25 – 28 cm, and the depth of subsoiling can be increased to 30 cm. The same land can be ploughed deep every 2 – 3 years.

4.1.2 Harrowing and pressing to preserve soil moisture. Harrow time was from the "beginning of autumn" to autumn sowing time, and each time after rain, when the ground appeared white, it was necessary to harrow to break the soil compaction, and receive rain to keep moisture.

4.1.3 Covering to preserve soil moisture. During mulching in autumn, when the summer maize growth height was about 1 m, the wheat straw was rolled into small segments of about 5 cm, for covering 3 000 kg per hectare, and they were spread evenly in the field, which could prevent soil hardening and inhibit evaporation of soil water. When wheat straw was turned into soil before sowing, the soil organic matter content could be increased and soil fertility could be improved.

4.2 Full application base fertilizers

The dry-alkali land could not be watered, and the effect of top-dressing was poor, so the basal application of fertilizers was recommended. The organic fertilizer, nitrogen fertilizer, phosphorus fertilizer and potassium fertilizer were applied at the bottom of cultivated land. In general, the ammonium carbonate and superphosphate were applied at 750 – 1 125 kg/ha and potassium sulfate at 150 – 225 kg/ha in low yield wheat fields.

In order to increase soil fertility and create high-yield wheat fields in dry-alkali land, farmers usually applied 30 000 kg/ha manure, 450 kg/ha diammonium, 150 – 225 kg/ha urea, 150 kg/ha potassium sulfate and 15 kg/ha zinc sulfate. The wheat seedlings were made grow early and quickly, laying the foundation for the growth of spikes, grain-increasing and weight-increasing after spring.

Fertilization depth was generally controlled under 20 cm, fertilizer was applied deeply, water and fertilizer could be used in the lower layer, and water and fertilizer could be used synchronously, so as to adjust fertilizer by water.

4.3 Fine land preparation

After harvest of autumn crop, wheat should be prepared carefully before sowing, and the depth of rotary tillage should be 15 cm, so as to form an effective plough layer. It was necessary to pay attention to the harvesting, ploughing, raking and sowing, to reduce the evaporation of soil water, control soil moisture, and create a good soil environment.

According to the soil moisture before sowing, the sowing plan of wheat was determined.

When there was sufficient soil moisture, the soil moisture content was more than 2 700 m\(^3\)/hectare before sowing. The planting area of dry land wheat could be enlarged appropriately without considering rainfall during wheat growth. When there was moist soil moisture, the soil water content was 2 250 m\(^3\), and the yield of wheat was poor. When there was low soil moisture, the it was difficult to ensure the yield of wheat because the soil moisture content is less than 1 800 m\(^3\). We should select dry and fertile land and increase the intensity of drought-resistance measures to ensure dry land wheat production.

4.4 Seed treatment

The medicament was used for seed dressing. Seed was dressed with . To control root disease, 2% Tebuconazole was selected for seed dressing according to 0.1% – 0.15% of seed amount, or 20% ketotriazole was selected for seed dressing according to 0.15% of seed amount. In the control of underground pests, 40% methyl isophos EC or 35% methyl thiocarbophos EC were used for seed dressing according to the seed amount of 0.2%. In the land with mixed diseases and pests, the above fungicides and pesticides were mixed for seed dressing.

4.5 Sowing adjustment

4.5.1 Sowing date. The sowing date of wheat in dry-alkali land should be determined according to the daily average temperature of 16 – 18°C. Cangzhou should strive for early sowing around October 1.

4.5.2 Soil moisture during sowing. When wheat was sown, the soil water content in 0 – 10 cm soil layer was 70% – 80% of the relative field water holding capacity. When the wheat seeds were sown, the soil moisture content in the plough layer was within the range of 10% – 15%, and positive measures could be taken according to the different moisture content. More harrows should be taken to increase the moisture content for early sowing.

4.5.3 Seeding rate. The seeding rate of wheat in dry-alkali land also obeys the soil moisture content. According to the soil moisture type in different years, the seeding rate of wheat in dry-alkali land should be reduced when there was low soil moisture, and the seeding rate of wheat in dry-alkali land should be 105 – 135 kg/ha; when there was sufficient soil moisture, the seeding rate of wheat in dry-alkali land should be increased by 120 – 165 kg/ha, so as to make full use of the soil moisture content.

The seeding rate and sowing time should be coordinated.
the basis of the seeding rate of 135 kg/ha, the sowing time before September 25 was 1 day earlier, the seeding rate was reduced by 7.5 kg, and the smallest quantity of basic seedlings was 2.1 million/ha. When the seed was sowed one day later after September 25, the seeding rate increased by 7.5 kg, and the maximum quan-

tity of the basic seedlings was 2.25 million/ha. After the basic seedlings were determined, the seeding rate could be calculated according to the number of seeds per kg, germination rate and rate of emergence in the field.

The seeding rate is calculated as follows:

\[
\text{Seeding rate per hectare (kg) = } \frac{\text{Quantity of the basic seedlings per hectare } \times 1 \text{,000}}{1 \text{,000 } \times \text{Grain weight (g)} \times \text{Germination rate ( )} \times \text{Rate of emergence ( )}}
\]

4.5.4 Forms of sowing. The main sowing pattern of wheat in dry-alkali land is strip cropping with equal row spacing which is usually 20 – 22 cm. It also can be planted in large rows with the spacing of 28 cm and small rows with the spacing of 20 cm.

4.5.5 Seeding depth. In general, the sowing depth of saline-alkali soil is 4 – 5 cm.

4.5.6 Compaction after sowing. After sowing, the proper compaction was done based on the soil moisture content. When the soil was too wet, it could be compacted after the surface soil moisture was properly dispersed and soil turned whitened. It was best to use iron harrow to loosen the soil after the compaction, to ensure that the top layer of soil was in good condition.

4.6 Field management

4.6.1 Cultivating and hoeing. After each rainfall, the soil was hoed at a depth of 3 cm. When the soil thawed 3 – 4 cm in early spring, thawed in day and frozen at night, the land was harrowed in cold temperature, and the soil water evaporation loss after thawing should be reduced by cutting off the running of capillary water.

4.6.2 Compaction. After the wheat field soil began to freeze before the winter, it was compacted in the warm and sunny noon and afternoon, and the clod was crushed, so that the ground was covered with crushed soil, conducive to cold resistance and overwintering. When the surface soil was dry in the early spring, it should also be compacted, so that the deep layer of water could be extended to the capillary to raise the soil moisture. After the soil moisture was raised, the surface layer was hoed, so that the water could be retained in the root layer for wheat to absorb.

4.6.3 Top dressing while there is sufficient moisture in the soil. When the mud was returned in early spring, urea was applied on the back of ridge at the rate of 150 – 225 kg/ha. When the wheat field was defertilized, the soil moisture could be used during dressing when the rain fell.

4.6.4 Prevention and treatment of diseases and pests. As for the field weeds, the broadleaf weeds could be controlled with 10% Tribenuron wettable powder. The uncontrolling weeds could be prevented with 3% Sigma oil suspension spray. The weeds were uprooted artificially in the serious fields. The wheat powdery mildew, leaf blight and rust disease could be controlled by spraying 20% Triadimefon EC or 15% Triadimefon powder, 12.5% Diniconazole powder mixed with water. To control wheat aphid, 50% Prinicarb powder or 40% Omethoate mixed with water could be sprayed. To control the wheat midge, during the period from heading to flowering, 80% Dichlorvos, or 40% Omethoate, 40% Isofenphos-methyl, 50% Phoxim EC mixed with water could be sprayed. It could not only control wheat midge, but also control leaf-eating pests.

4.6.5 Anti-senescence and weight increase. During the early and middle period from heading to filling, 3 kg potassium dihydrogen phosphate mixed with 750 kg water was sprayed on the leaves per hectare in order to prevent dry and hot air, delay senescence and increase the grain weight. Insecticides, fungicides and potassium dihydrogen phosphate could be mixed to achieve multiple purposes by one-time spraying.

4.7 Timely harvesting The best harvest time of wheat was at the end of the dough stage to the full ripening stage, so the wheat should be harvested at the right time. After harvesting, the seeds were dried until the moisture content was less than 12.5% (national standard) and stored.

References


