ISSN: 2688-8645

A Review of Maize Seed Production Technology in Spring-Sown Area

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Abstract

In recent years, with the rapid development of modern agriculture in China and the continuous acceleration of maize industrialization, the planting area of maize in spring sowing area is constantly improving, and the area of seed production is also expanding. However, while the area of spring sowing corn seed production continues to expand, the phenomenon of unqualified seed quality, yield reduction and even no harvest caused by improper seed production technology and cultivation management occurs from time to time, which is bound to bring serious economic losses to seed production units and seed farmers. In view of this problem, this paper summarizes the effective measures of maize seed production in the spring sowing area, and points out the key links, in order to break through the bottleneck in maize single seed production, and finally achieve the goal of win-win situation for seed production units and seed farmers.

Keywords

Spring Sowing; Corn; Seed Production; Measures.

1. Introduction

Corn is an important food crop in China, with high nutritional value and wide range of uses, and plays a pivotal role in China's food processing, medicine, paper industry, textile industry, especially animal husbandry. Due to the vast territory of our country, the planting of corn in China can be divided into different regions, including Heilongjiang, Jilin, Liaoning, Ningxia, Inner Mongolia and other provinces (autonomous regions) from 40 ° to 50 ° north latitude, Shanxi, Hebei, Shaanxi and part of Gansu are spring sowing corn areas, the total area of corn in this area is about 6.67 million hm2, accounting for 30% of the total area of corn in the country, and the output accounts for about 35% of the country's main corn producing areas. [1] The spring sowing area of corn has long sunlight and strong commerciality of corn seeds, and many seed companies have set up seed production and production bases here. However, with the expansion of corn seed production base and the gradual expansion of corn seed production area, the quality of corn hybrids has become increasingly prominent, including seed purity, yield and disease resistance, which has become a problem that plagues seed production companies, scientific research institutions and other seed production departments. After visiting and researching, combined with the actual seed production in this department, this paper summarizes several technical measures suitable for seed production in spring-sowing areas, in order to solve the above outstanding problems and provide reference for high-yield seed production of spring-sown maize.

ISSN: 2688-8645

2. The Basis for Improving the Quality and Yield of Seed Production

2.1. Strict Selection and Selection Criteria for Seed Production Sites

A basic condition for successful corn seed production is to choose a good seed production site. The quality of the seed production site depends on whether it is conducive to the growth and development of maize parental inbred lines. This is related to whether the plant can be reproduced, whether the genetic composition of the plant will change, etc. [2] Secondly, the monthly accumulated temperature and temperature changes of the main growth cycle of maize in the location of maize seed fields and the occurrence of common diseases, pests and weeds were considered. In addition, it should be considered that no other maize can be planted within 400-500 m of the selected seed plot, and the selected plot does not belong to the maize continuous cropping plot where self-growing maize occurs. Finally, it is necessary to consider whether the transportation of seed production is convenient, and try to reduce the cost of seed production caused by the transportation of seeds, fertilizers, etc., and the transportation of harvested seeds.

2.2. Select Appropriate Contracted Farmers

First of all, we must choose farmers who are honest, reform-conscious, progressive, and flexible-minded, and preferably have experience in seed production. Secondly, the seed production unit should communicate with the agricultural supervision department of the selected seed production area, and require them to work hard to coordinate with the local government and farmers, and incorporate seed production into the main production projects of the local government and farmers, so that they can perceive that the economic benefits of the seed production industry are very considerable, so as to improve their labor enthusiasm. Finally, seed production enterprises and units should sign seed production contracts with the townships, villages and farmers who produce seeds, and act in strict accordance with the technical operating procedures and contracts to avoid all kinds of disputes.

3. Main Technical Measures and Key Links of Seed Production

3.1. Strictly Control the Sowing of Seeds

The quality of sowing is self-evident for the whole seed production process, and it is very important to prepare for sowing in advance and master the sowing period. The germination rate should be tested before sowing, and the parents must be stacked separately, and it is best to distinguish the parents with different colors of seed coatings, and the parents should not be mixed in the sowing process. When sowing, parents must be divided into branches to sow seeds, interphase planting, to uniformly stipulate the ratio of parents to the bank, sowing to prevent reseeding, missed sowing, crossing, mixed planting and staggered rows. A parent-to-parent ratio of 1:4, 1:5 or 1:6 is appropriate. 1:6 is appropriate for the female parent with an upright upward stroke, and 1:4 for the female parent with a flat leaf type. In addition, the ratio of parents to the parent bank in the production of seeds by American seed companies is mostly 1:4, and a few are 1:6.

The sowing time should be considered around mid-April, and it is necessary to choose a sunny day for sowing, and it is necessary to achieve concentrated sowing for easy management. If the sowing time is too late, there is a risk of freezing in the late growth period of the corn. After the sowing time was determined, Li Fanghua et al. [3] believed that the sandy soil should be watered 3~4 days in advance, the clay soil should be watered 6~7 days in advance, and the white soil should be raked and sown immediately, and the timing should not be delayed.

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3.2. Standardize the Mechanized Operation of Sowing

With the rapid development of hybrid corn seed industry, the application of agricultural machinery has also increased year by year. However, many contradictions are exposed in the sowing operation, such as agricultural machinery households can not keep up with the upgrading of agricultural machinery, can not reasonably deploy agricultural machinery, the progress of field sowing operations and the quality of operations are contradictory, and the existing agricultural machinery can not completely solve the problem of labor shortage. Therefore, the standardization of corn seed production agricultural machinery at the time of sowing can reduce the negative impact caused by inadequate operation to a certain extent. Song Xiuhua et al. [4] believed that the seeding machinery could choose the 2BP-2P double-row corn film seeder from Dengkou, Inner Mongolia. In addition, professional training should be provided to the drivers of corn planters to improve the level of operation.

3.3. Cultivation Management

It can be said that the beginning of sowing is done well to provide a guarantee for the improvement of the yield and quality of corn seed production, but the cultivation and management of corn throughout the growth period can be said to be the key work in the corn seed production process, and the top priority.

3.3.1. Fertilizer and Water Management

Different fertilization methods are used depending on the type of soil. Jiang Jianfeng et al. [5] showed that 25kg/667m^2 of diammonium phosphate plus 2.5kg/667m^2 of urea should be applied to sandy loam soil, 50kg/667m ^{2}of ammonium carbonate should be applied at jointing stage, and 25kg/667m^2 of urea should be applied at intervals of water20kg/667m^2 of compound fertilizer should be topapplied at the large bell stage, and 10kg/667m^2 of urea should be topdressed after pollination; In the clay loam soil, 35kg/667m^2 of diammonium phosphate and 2.5kg/667m^2 of urea were applied to reduce the amount of top dressing. Sun Jie et al. [6] proved that the correlation between the main indicators of seed yield and seedling physiological quality of maize hybrid seed production and nitrogen fertilizer application rate reached a significant or extremely significant positive correlation level under the medium fertility conditions of white clay soil in northern China, and the range of 0~450kg per hectare of N. In addition, Sun Jie [7] showed that P2O/hm^2 was the best application rate under moderate fertility conditions in white clay soil in northern China$_5$150kg. Lan Yuncai et al. [8] showed that the application of medium and trace element fertilizers such as magnesium sulfate, manganese sulfate and zinc sulfate in maize fields with high pH value could make the leaves green, improve the pollination rate, and help increase yield.

Corn watering should not be too late in the squatting seedling stage, so as not to cause drought, keep the soil moist after jointing, and water the soil immediately when the soil is slightly dry. In the heading and flowering period, sufficient water should be ensured, and there must be no "stuck neck drought". In September, water should be controlled to prevent freezing damage to corn in the later stage.

In addition, the fertilizer and water management of maize in the middle and late stages should be strengthened to ensure that there is enough fertilizer and water to meet the needs of maize growth and development, and enhance drought resistance and lodging resistance. Corn should be kept moist after jointing, and the soil should be watered immediately when it is slightly dry.

3.3.2. Removal of Impurities in Stages

3.3.2.1 Corn Seedling Stage (Emergence-Jointing) Weeding

After the emergence of corn, it should be planted during the 3~5 leaf period, and attention should be paid to removing miscellaneous plants while interseeding. There are mainly self-grown seedlings, non-parental self-bred seedlings, hybrid seedlings, etc., and the hybrid plants

ISSN: 2688-8645

at this period are different from normal plants in terms of roots, stem nodes, leaf hairs, leaf margins, leaf shapes, leaf stretching, plant height, etc., which are easier to identify and easy to remove.

3.3.2.2 Removal of Impurities in the Middle of Maize (Jointing-Heading).

During this period, the removal of impurities was mainly based on the agronomic and morphological characteristics of the variety, which was also a critical period for the prevention of genetic contamination.

3.3.2.3 Late Maize (Heading-maturity) Deweed

In the grain filling stage, the impurities can be removed in terms of color, water content, disease resistance, etc., as well as the growth or reproductive characteristics of the abnormal webrids, which is the last removal of impurities before harvest. After maturity and harvesting, the panicle should be selected according to the grain color and panicle type, and all miscellaneous ears should be removed.

3.3.3. Flowering Adjustment

One of the key problems faced in corn seed production is the inconsistent flowering date of the parents. When the parents of the hybrid have different growth periods, the parents can meet in flowering according to different methods. One of the most common methods is to delay the sowing of a particular parent. Li Liangcheng et al. [9] believed that when the parents were sown at different sowing depths, that is, every 2A depth of 5 cm delays plant growth and development by two days, but this method is limited to parents with more vigorous seeds. Su et al. [10] suggested that the application of base fertilizer could advance or delay the growth of crops by one to two days, the application of phosphorus fertilizer would advance plant development, and the application of potassium fertilizer would delay plant growth. However, the results were less consistent in soils with high fertility and more effective in soils with low fertility. Du Rubiao et al. [11] concluded that coating the parent seeds, such as polyurethane coating, could delay germination by 6 days, but this method may be dangerous to use and will also cause soil compaction. Wu et al. [12] suggested that the use of flame gun spraying or liquid nitrogen to burn the male plant when it was about 15 cm tall and the growth point was still below the soil surface could delay pollen production by 3~6 days. Tian Guixia et al. [13] experimentally showed that the female filigree was pruned25~4cm, which can advance the flowering period of the mother parent by 1~2d. In addition, in cold areas, plastic film can be used to insulate a parent, which can also make the flowering period meet.

In summary, the above methods are based on the early prediction of the flowering period of the hybrid parents, so the breeder must grasp the physiological characteristics of the parents in different production locations and different latitudes, and follow the principle of promoting slow and fast regulation, so as to help the parents meet at the flowering stage. In addition, most of the above methods exert a certain amount of pressure on maize plants, but the ability of maize inbred lines to withstand stress is often limited, and different inbred lines also have different responses to stress, which is a problem that must be considered in maize seed production.

3.3.4. Female Parent de-male

In hybrid maize seed production, the emasculation process is the most critical and difficult to master. In order to achieve the required standard of genetic purity, all male flowers of the female parent must be removed before pollination or silk stripping to allow the female and male parents to be crossed. De-emasculation should be timely, clean and thorough. The traditional method is to remove the male panicle after the female male panicle is extracted, before pollin, and before 10:00 a.m. every day, rain or shine, and bury it in the soil. Gao Feng et al. [14] proved through experiments that the emasculation of 1~2 leaves in the mother of the hybrid maize

ISSN: 2688-8645

seed field did not cause yield reduction compared with the emasculation without leaves. In addition to artificial emasculation, there are mechanical emasculation, chemical emasculation, and biotechnological emasculation [2]. Wu Xianxian [15] confirmed through a visit to the Limagrain farm in France that the company's seed farm was reluctant to use mechanical emasculation to cut off the male ears together with more than 3 leaves, which affected the accumulation of dry matter, and still mainly used manual emasculation. Therefore, it is correct to adhere to the practice of artificial emasculation in maize seed production in spring-sowing area.

3.3.5. Prevention and Control of Diseases, Insects and Weeds

There are many kinds of maize diseases, insects and weeds in spring sowing area, and the occurrence degree of corn in different regions and different years is different, and each growth stage will be harmed by different pests from sowing to maturity. Doing a good job in the prevention and control of diseases, insects, and weeds plays a role that cannot be ignored in improving the yield and quality of seed production.

For seedling fungal diseases such as top rot and seedling blight, the rhizomes can be sprayed with 1000~1500 times of 20% triazolone emulsifiable concentrate or 1500 times of 85% trichloroisoururic acid soluble powder. At the same time, 1500~2000 times of Yunda 120 can be added to improve plant disease resistance. For corn large spot disease, Curvularia leaf spot, brown spot, rust and other common leaf diseases of corn in the late stage of jointing, 12.5% enazole (Heguoli) wettable powder can be sprayed with 1000~1500 times liquid.

For underground pests such as grubs, ground tigers, mole crickets, and root bugs, 48% chlorpyrifos EC can be used 800~1000 times of liquid. To control armyworm, cotton bollworm and other lepidopteran larvae, 4.5% cypermethrin emulsifiable concentrate 2000 times liquid spray. The control of corn borer and second-generation armyworm can be mixed with 40% hydrothionphos 500 times liquid mixed with fine sand and sprinkled in corn heart leaves, and combined with red-eyed bee control, the effect is good. For the seed production field where the occurrence of aphids is more serious, 10% imidacloprid wettable powder can be sprayed with 1000~1500 times liquid. In addition, in the spring sowing area, attention should be paid to the prevention and control of corn red spider in July and August, and once a large occurrence occurs, it is necessary to mix 20% dicofol EC and 73% gram mite EC with water, and use a fog machine to spray pesticides in windless weather at night [5].

For annual and perennial gramineous weeds, sedge and broad-leaved weeds, herbicides such as 40% ethyl and herbicide can be used for pre-emergence soil treatment after corn sowing, such as 40% ethyl and herbicide and 20% 2-methyl4chloride saline. After seedlings, manual weeding should be used as much as possible, because chemical weeding is easy to cause pesticide damage to some parents who are sensitive to pesticides.

3.4. Harvesting and Threshing

In recent years, due to the relatively long growth period of the bred varieties in some spring-sown areas, due to the influence of climatic factors, the extreme low temperature comes early, and the seed corn is easy to freeze. Therefore, in the later stage of corn growth, we should pay attention to water control, it is strictly forbidden to water white dew, and it is necessary to harvest in advance, generally to start harvesting around September 20, and dry while harvesting, so that the moisture of corn can be reduced from 30% ~ 40% to below 20%.

The fruiting spike on the mother parent is the prepared hybrid, after harvesting, the shaft is spread out and dried and the heteropanicle is removed in time according to the grain type and shaft color, and can be threshed and dried only after the acceptance of professional and technical personnel. When the moisture content of corn drops to less than 14%, it is selected, that is, it is harvested, stored and taken off separately to prevent mixing and mildew to ensure increased yield and income. Selected can be bagged and ordered.

ISSN: 2688-8645

4. Research and Prospect of New Seed Production Technology

At present, the new seed production technologies used by individual breeding units mainly include maize sister cross seed production technology and maize male sterile line seed production technology.

The maize sister breeding system took advantage of the slight heterogeneity of genetic components between sister lines, and masked the purity and state of some recessive genes, so as to obtain a certain degree of heterosis, improve the growth potential and yield of plants, and reduce the adverse effects of inbreeding decline. In addition, Shao et al. [16] argued that by taking advantage of the similarity of the genetic basis between sister lines, sister crosses maintained the original specific genotype sequence and coordination ability of the inbred line. The Sichuan Provincial Maize Sister Cross and Improved Single Cross Utilization Cooperative Group has experimented with the technology of using sister varieties to replace the corresponding inbred lines to improve maize seed production, and has proved that the use of maize sister cross seed production technology can increase seed production by more than 30% [17]. The adoption of the sister seed system technology has significantly improved the viability of the parents, which has made it possible to broaden the adaptation area of seed production to the mountainous drylands, thereby leading to the great development of agriculture in the mountainous areas.

In particular, in 1998, Xiangfan Zhengda Seed Company applied Yuyu No. 22 sterile line seed production in Henan Province, which caused a large area of extinction in Henan Province, which brought huge losses to producers, and caused the call for sterile lines to be shot in the seed world [18]. Zhou Baojiang et al. [19] concluded that the use of maize male sterile lines not only eliminates the need for manual tasseling, but also allows the male seeds to be used continuously under the condition of safe seed production and high paternal purity. The number of quarantine areas is reduced, and the cost of seed production is reduced. Therefore, in the long run, sterile line seed production will definitely have great development, and the technology will be more widely used.

The production of maize hybrid seeds is mainly based on monocrosses, and in most cases the method of artificial emasculation is still adopted, and the application of sister crosses and sterile line seed production technology has not been widely promoted in production, so increasing the development and application of these two technologies has broad prospects for breeding units.

5. Conclusion

The ultimate goal of improving corn seed production technology is to do everything possible to improve the quality and yield of seed production, as long as we master the key technical links in the sowing and field management in the seed production process, it will definitely make seed enterprises and production units obtain good benefits, and corn seed production as a high-efficiency agricultural model is destined to attract more and more farmers and farms and join it, and ultimately achieve a win-win situation.

Acknowledgments

This work was supported by the Student Innovation Project of Jilin Agricultural Science and Technology College (#X202511439048).

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ISSN: 2688-8645

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