Analysis of Growth Stage Characteristics and Cultivation Techniques for Wheat Variety New Century 999

Jiangpeng HONG[1], **Tongfu MA**[2*]

1. Anhui New Century Seed Industry Technology Company Limited, Fuyang 236069, China; 2. Fuyang Normal University, Fuyang 236037, China

Abstract Wheat is one of the primary grain crops in China and is widely cultivated. Successful cultivation requires careful selection of varieties, seeding, fertilization, and pest control to ensure adequate nutrient absorption by roots and improve lodging resistance and disease tolerance. This study investigated the cultivation techniques of the wheat variety New Century 999, and examined its growth stage characteristics and cultivation requirements. The analysis identifies challenges in its cultivation and provides recommendations for pre-sowing preparation, land preparation, seeding, fertilization, and management practices in both winter and spring.

Key words Wheat; New Century 999; Cultivation technique

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As the world's largest wheat producer and consumer, China's agricultural stability heavily relies on the continuous improvement in wheat quality and yield[1]. According to FAO statistics, wheat accounts for 40% of national grain consumption and 22% of total grain production in China, making its cultivation vital for national food security. The Huang – Huai Wheat Region is the largest wheat-producing area in China, covering 16.026 million hectares and yielding a total of 102.71 million tons, accounting for approximately 68% of the national wheat planting area and 75% of total wheat production. The New Century 999 variety, with its superior gluten quality (protein content reaching 14.5%) and high yield potential (average 8.5 – 9.5 t/hm^2 under optimal conditions), has emerged as a breakthrough cultivar in recent years. However, realizing its full genetic potential requires systematic implementation of precision cultivation protocols.

Growth Stage Characteristics of Wheat

Growth period

The growth period of wheat spans from seed emergence to maturity and is influenced by various factors, including variety and cultivation methods. Generally, higher altitudes and latitudes extend the growth period, while lower latitudes result in shorter periods. Even within the same region, different varieties exhibit significant variations in growth duration[2]. For instance, spring wheat grows and matures quickly, whereas winter wheat, due to colder weather, develops and matures more slowly. The sowing time also impacts the growth period, which includes stages such as seed germination and emergence, each with distinct developmental characteristics[3]. Typically, the growth period of winter wheat can be divided into seedling, tillering, jointing and booting, and heading and grain-filling stages.

Growth characteristics

Wheat growth undergoes two sequential physiological stages, vernalization and photoperiod sensitivity stages, that collectively regulate developmental progression and yield outcomes. The vernalization stage, essential for winter wheat to transition from germination to robust vegetative growth, requires exposure to low temperatures for a specified duration. Failure to meet these requirements results in growth cessation or developmental abnormalities. Based on vernalization demands, wheat varieties are categorized into three types: winter wheat (requiring 23 – 50 d at 0 – 3 ℃), semi-winter wheat (15 – 35 d at 0 – 7 ℃), and spring wheat (5 – 15 d at 0 – 12 ℃). Following successful vernalization, wheat enters the photoperiod stage, when sufficient sunlight is essential for growth[4]. As a long-day plant, wheat's heading accelerates under extended sunlight exposure, whereas insufficient illumination delays reproductive development. Photoperiod responsiveness further classifies varieties into two groups: slow-reacting types, which necessitate at least 16 d of 8 – 12 h daily light to initiate heading, and moderately-reacting types, requiring over 25 d of 12-h daylight for optimal progression[5]. This temperature-light interplay underscores the necessity for precision in varietal selection and cultivation scheduling to align genetic traits with regional climatic patterns, ensuring both physiological fulfillment and maximal yield potential.

Cultivation Requirements

Suitable varieties

Selecting an appropriate variety is crucial for optimal growth, considering the significant climatic and geological differences across regions. Southern China, with its higher temperatures and shorter daylight, is suited for spring wheat varieties. In contrast, the cooler temperatures and longer daylight in the north favor

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Jiangpeng HONG (1990 –), male, P. R. China, senior agronomist, devoted to research about the breeding and application of new wheat varieties.

* Corresponding author. Tongfu Ma, researcher, devoted to research about plant genetic breeding and high-yield cultivation techniques.

winter or semi-winter wheat varieties[6]. To enhance introduction success, varieties from regions with similar latitudes or climates should be chosen.

Sowing requirements

Spring wheat's short vernalization period means early sowing, and appropriate vernalization necessitates careful sowing schedule management, as premature planting may accelerate stem elongation (jointing) prior to winter dormancy, rendering crops vulnerable to terminal frost damage during cold weather. Therefore, strategic sowing postponement proves essential for yield optimization by aligning reproductive phases with favorable thermal conditions. Conversely, winter wheat cultivation demands early sowing to ensure adequate vernalization fulfillment and robust root establishment before soil freezing, capitalizing on chilling requirements for proper physiological development. Semi-winter wheat varieties present unique phenological challenges requiring precision scheduling: early-sown fields benefit from growth retardant applications to suppress precocious development, while late-planted plots necessitate intensified nitrogen supplementation and soil moisture conservation techniques to compensate for reduced tillering capacity and compromised photosynthetic efficiency. All cultivars require site-specific adjustments accounting for soil thermal properties, forecasted frost dates, and cultivar-specific Growing Degree Day (GDD) accumulations to balance vegetative/reproductive phase synchronization with regional climate patterns.

Sowing density

Sowing density critically governs wheat growth outcomes through its influence on interplant competition dynamics, canopy architecture optimization, and resource partitioning efficiency. Spring wheat cultivars require elevated seeding rates to compensate for their abbreviated growth cycle and limited tillering plasticity by maximizing initial plant establishment and light capture efficiency during rapid vegetative phases, while semi-winter wheat demands reduced densities to accommodate prolonged tiller development windows and mitigate intra-canopy shading risks in their extended growth duration. Strategic density adjustments must further account for climate unpredictability. Spring wheat's dense canopies buffer against early-season drought through soil moisture conservation, whereas semi-winter wheat's open architecture facilitates frost dissipation during reproductive phases, demonstrating how sowing density operates as both yield amplifier and environmental risk modulator in modern wheat cultivation systems.

Cultivation management

During the vernalization stage, extending the period can increase the number of spikes. In the photoperiod stage, rapid spike differentiation leads to smaller spikes[7]. Thus, proper attention to the growth period, nutrient management, and water supply is essential for achieving higher spike numbers.

Cultivation Techniques for New Century 999

Product overview

New Century 999 is a semi-winter wheat variety characterized by semi-erect seedlings, moderate tillering ability, and light green leaves of medium size. The plant height is approximately 75 cm, with strong lodging resistance, uniform spike layers, and a high spike formation rate. The variety is robust, heat-tolerant, and matures uniformly with a favorable grain-filling period. It has a bulk density of 820 g/L, medium maturity, and good post-maturity yellowing. The grain protein content is 14.8%, wet gluten content is 34%, and sedimentation value is 35 ml, with a stability time of 9.2 minutes.

Cultivation techniques

Pre-sowing preparation

(1) Site selection. Land selection serves as a pivotal determinant of sowing outcomes, necessitating fields with balanced agro-ecological parameters including moderate-to-high fertility levels, unobstructed terrain, sufficient solar exposure, and soil organic matter content maintained at 1.5% – 2.0% to ensure optimal nutrient availability and root development.

(2) Fertilization. Straw incorporation is a common method for increasing soil nitrogen content. Prior to fertilization, field size should be determined, and the proportion of organic and chemical fertilizers set to ensure sufficient soil fertility. Applying NPK fertilizers should be based on soil deficiency analysis and supplemented with trace elements as needed[8].

(3) Land preparation. After field selection, the land must be cleared of debris, leveled, and previous crop residues should be shredded to a maximum of 5 cm. Deep plowing should be conducted to enhance root growth, followed by fine tilling to improve soil aeration and light permeability.

(4) Watering. Soil moisture management requires maintaining a water content of 70% – 80% during the pre-sowing phase and ensuring a water-holding capacity of 60% – 65% during sowing. Moisture levels below 55% necessitates pre-sowing irrigation to prevent germination delays or seedling mortality.

(5) Seed treatment. The seeds should be soaked in a brassinolide solution and treated with diluted carbendazim before air-drying for sowing.

Sowing

Successful wheat sowing is crucial for robust seedling establishment, which is fundamentally determined by seed quality and adherence to precision protocols. Seeding should ensure uniform emergence, optimal disease resistance, and drought tolerance. The ideal sowing period is October 10 – 25, with the best timeframe from October 10 – 15. Seeding density must be calibrated to 120 000 – 180 000 plants per mu (approximately 180 – 270 plants/m^2) to balance interplant competition and light interception efficiency, with sowing depth strictly maintained at 4 – 5 cm to ensure optimal soil-seed contact, consistent moisture uptake, and protection against avian predation, thereby achieving synchronized emergence and maximizing photosynthetic potential during critical tillering phases.

Winter management

(1) Monitoring and supplementary seeding. Regular inspection

ensures optimal emergence, and light irrigation is carried out if needed. Precision supplementary seeding is implemented when emergence rate is not high enough.

(2) Weed control. Weeding should be conducted on sunny days between mid-November and mid-December.

(3) Fostering strong seedlings. Strong seedlings are indicated by robust stems, six leaves with one central leaf, and 5 – 7 secondary roots.

(4) Winter irrigation. Watering should be carried out in a manner of spray or micro-spray irrigation from late November to early April.

(5) Frost prevention. Fertilizers and water are applied in early spring to mitigate frost damage and promote recovery.

Spring management

(1) Green-up stage. The growth of wheat seedlings should be closely monitored, and light irrigation is adopted to improve cold tolerance accordingly.

(2) Jointing to flowering stage. It is necessary to ensure adequate nutrition and water, so as to strengthen stalks and increase spike number.

(3) Flowering to grain-filling stage. Root and leaf health should be maintained to avoid early senescence and promote grain filling.

Harvesting Wheat harvesting typically commences in early June, though regional climatic variations and varietal-specific maturation periods dictate precise scheduling. Mechanized harvesting systems enhance operational efficiency while reducing field losses, but they necessitate rigorous post-harvest protocols where immediate drying becomes critical to inhibit mycotoxin formation and preserve germination viability.

Conclusions

Wheat quality and yield significantly influence China's agricultural development. Advanced cultivation techniques and efficient management practices are necessary for high-quality yields. Adopting techniques adapting to local conditions and effectively managing the field are key to successfully cultivating the wheat variety New Century 999 and enhancing disease control measures.

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