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# Study on Yield and Traits of Different Maize Varieties in Chuxiong Prefecture

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**Abstract** The new maize variety test was conducted to select fine varieties suitable for the ecological environment in Chuxiong Prefecture and speed up the variety upgrading. The results showed that Yunrui 392, Yunrui 407 and Yunrui 7 had good comprehensive traits, great lodging resistance, stable yield and good disease resistance, and their yield was 9531.3, 9312.5 and 9250.0 kg/ha, respectively, close to the yield of control variety Beiyu 16, indicating that the yield potential was large and they could be planted in Chuxiong to replace the varieties with low yield and poor resistance.

**Key words** Maize, Variety, Yield, Traits

## 1 Introduction

Maize is one of the major food crops in Chuxiong Prefecture, and improving the area and yield is always an important measure to promote sustained and stable yield of food crops across the prefecture. Currently, there are 180 commercially available maize varieties in Chuxiong Prefecture[1], and farmers find it difficult to choose variety because improper seed selection will lead to output reduction and even crop failure. To promote the upgrading of local maize varieties, play the role of fine variety in agricultural production and help farmers to choose varieties, the adaptive research of new maize variety was conducted in 2015 under the support of Yunnan modern agricultural technology system. It helps to speed up promotion of new maize variety and transformation of new achievements, select more high-quality safe new hybrid maize varieties with good lodging resistance and high yield suitable for planting in Chuxiong Prefecture, provide a new maize variety platform and window to local governments, farmers and seed industry, timely find the problems in production, avoid the risk of agricultural production, and provide a scientific basis for rational distribution of maize variety and large-scale new maize variety production in Chuxiong Prefecture.

## 2 Materials and methods

**2.1 Test point** The test point (101.75°E, 25.23°N) was in Qinglongqiao base of Chuxiong Institute of Agricultural Science Research and Extension, with an altitude of 1772 m, average annual temperature of 15.7℃ and precipitation of 830 mm. The rainy seasons were mostly concentrated in July to September. The ground was open, transportation was convenient and terrain was flat. The soil was deep red loam, and the previous crop was rapeseed.

**2.2 Test varieties** There were 21 test varieties, including a control variety: Beiyu 16 (CK), Yunrui 505, Yunrui 407, Yunrui 392, Yunrui 7, Yunrui 506, Yunrui 322, Yunrui 222, Yunrui 123, Yunrui 465, Yunrui 89, Yunrui 102, TRL7, Yunrui 3915, Yunrui 212, Yunrui 3911, TRL3, Yunrui 668, Yunrui 108, Yunrui 339, Yunrui 62. Except Beiyu 16, all varieties were provided by Yunnan Academy of Agricultural Sciences.

**2.3 Test design and field management**

**2.3.1** Test design. The test set 22 treatments, namely a variety as a treatment, and the local main variety Beiyu 16 was selected as the control (CK). The plot was 5-row plot and the planting was conducted based on equal row spacing. The row spacing was 0.8 m, and pond spacing was 0.4 m. The row length was 4 m, with no replication, and the planting density was 62505 plants/ha. The bunch planting was used and sowing time was May 23, 2015. 450 kg/ha special compound fertilizer for maize was applied during planting, and 300 and 450 kg/ha urea was applied at jointing stage and big trumpet stage, respectively[2]. Irrigation was done after sowing to ensure emergence uniformity. The thinning date was June 15 and final singling date was June 20. The control of other pests was managed according to the field management manual. The harvest date was October 25.

**2.3.2** Measurement items and methods. The growth and development process was recorded during growing period. The grey speck disease, leaf blight, maximum plant height, ear height and number of productive ear per plant were recorded in the field. During the maturity period, 3 rows of maize in the middle of plot were harvested and dried and the yield was determined (excluding 14% of water content). 10 representative ears were selected for indoor examination of some traits (ear length, ear diameter, shaft diameter, ear row number, number of kernels per row and thousand kernel weight) and calculation of the seeding rate.

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**Table 1 Comparison of growth characteristics of various varieties**

| Varieties \ Traits | Growth period//d | Plant height//cm | Ear height//cm | Ear position ratio//% | Plant type | Number of productive ear per plant | Ear type | Grain type | Grey speck disease level | Leaf blight level |
|---|---|---|---|---|---|---|---|---|---|---|
| Beiyu 16 (CK) | 125 | 260 | 70 | 0.27 | Half | 1.05 | Column | Horse teeth | 0 | 0 |
| Yunrui 505 | 120 | 270 | 90 | 0.33 | Tight | 0.95 | Column | Horse teeth | 0 | 0 |
| Yunrui 407 | 119 | 270 | 110 | 0.41 | Flat | 0.90 | Cone | Horse teeth | 0 | 0 |
| Yunrui 392 | 126 | 290 | 110 | 0.38 | Half | 0.80 | Column | Horse teeth | 0 | 0 |
| Yunrui 7 | 126 | 240 | 90 | 0.38 | Half | 0.95 | Column | Hard grain | 0 | 0 |
| Yunrui 506 | 124 | 295 | 110 | 0.37 | Tight | 0.85 | Column | Semi-horse teeth | 0 | 0 |
| Yunrui 322 | 127 | 250 | 80 | 0.32 | Half | 0.95 | Cone | Horse teeth | 0 | 0 |
| Yunrui 222 | 118 | 280 | 120 | 0.43 | Half | 0.80 | Cone | Horse teeth | 1 | 0 |
| Yunrui 123 | 119 | 250 | 80 | 0.32 | Half | 0.70 | Column | Horse teeth | 1 | 0 |
| Yunrui 465 | 124 | 230 | 80 | 0.35 | Flat | 0.70 | Cone | Hard grain | 1 | 0 |
| Yunrui 89 | 121 | 250 | 85 | 0.34 | Half | 0.80 | Column | Horse teeth | 0 | 0 |
| Yunrui 102 | 127 | 260 | 110 | 0.42 | Half | 0.80 | Column | Horse teeth | 0 | 0 |
| TRL7 | 126 | 280 | 150 | 0.54 | Half | 0.85 | Column | Semi-horse teeth | 0 | 0 |
| Yunrui 3915 | 120 | 260 | 90 | 0.35 | Flat | 0.80 | Column | Semi-horse teeth | 0 | 0 |
| Yunrui 212 | 117 | 250 | 95 | 0.38 | Half | 0.75 | Column | Horse teeth | 0 | 0 |
| Yunrui 3911 | 126 | 280 | 105 | 0.38 | Half | 0.80 | Column | Horse teeth | 0 | 0 |
| TRL3 | 118 | 280 | 105 | 0.38 | Flat | 0.85 | Cone | Semi-hard grain | 3 | 3 |
| Yunrui 668 | 126 | 250 | 90 | 0.36 | Flat | 0.80 | Column | Semi-horse teeth | 0 | 3 |
| Yunrui 108 | 117 | 240 | 100 | 0.42 | Half | 0.75 | Column | Hard grain | 0 | 3 |
| Yunrui 339 | 117 | 255 | 95 | 0.37 | Half | 0.85 | Column | Horse teeth | 0 | 0 |
| Yunrui 62 | 123 | 280 | 95 | 0.34 | Half | 0.75 | Column | Semi-horse teeth | 0 | 0 |

**Table 2 Comparison of ear traits and yield of different varieties**

| Varieties \ Traits | Ear length//cm | Ear diameter//cm | Bald tip length//cm | Ear row number | Number of kernels per row | Grain number per ear | Seed rate//% | Thousand kernel weight//g | Grain weight per plant//g | Yield kg/ha | ±% compared with the control |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Beiyu 16 ($CK_1$) | 18.4 | 5.1 | 2.7 | 16.4 | 34.6 | 567 | 87.7 | 295 | 166.7 | 10937.6 | – |
| Yunrui 505 | 17.7 | 4.7 | 1.1 | 14.4 | 31.8 | 458 | 81.9 | 345 | 145.3 | 8625.0 | -14.7 |
| Yunrui 407 | 18.3 | 5.1 | 0.8 | 14.8 | 34.0 | 503 | 84.7 | 385 | 165.6 | 9312.5 | -7.9 |
| Yunrui 392 | 19.3 | 4.7 | 1.7 | 12.8 | 38.2 | 489 | 84.7 | 375 | 190.6 | 9531.3 | -5.7 |
| Yunrui 7 | 17.4 | 4.9 | 1.6 | 15.6 | 31.2 | 487 | 85.8 | 345 | 155.8 | 9250.0 | -8.5 |
| Yunrui 506 | 15.7 | 4.7 | 0.7 | 14.8 | 34.6 | 512 | 87.5 | 305 | 161.2 | 8562.5 | -15.3 |
| Yunrui 322 | 15.8 | 5.1 | 0.9 | 15.2 | 29.8 | 453 | 85.0 | 385 | 134.7 | 8000.0 | -20.9 |
| Yunrui 222 | 18.6 | 4.7 | 1.3 | 14.0 | 38.0 | 532 | 83.8 | 295 | 158.1 | 7906.3 | -21.8 |
| Yunrui 123 | 18.2 | 4.8 | 1.7 | 13.2 | 35.4 | 467 | 87.2 | 355 | 170.7 | 7468.8 | -26.1 |
| Yunrui 465 | 18.3 | 5.2 | 1.6 | 16.0 | 31.8 | 509 | 82.7 | 325 | 167.9 | 7343.8 | -27.4 |
| Yunrui 89 | 16.3 | 4.8 | 0.7 | 14.8 | 33.2 | 491 | 85.2 | 385 | 150.6 | 7531.3 | -25.5 |
| Yunrui 102 | 17.8 | 4.6 | 1.4 | 13.6 | 37.8 | 514 | 82.2 | 300 | 138.8 | 6937.5 | -31.4 |
| TRL7 | 16.0 | 4.7 | 1.2 | 13.2 | 34.8 | 459 | 86.8 | 340 | 154.1 | 8187.5 | -19.0 |
| Yunrui 3915 | 16.2 | 5.0 | 0.9 | 16.0 | 35.6 | 570 | 87.0 | 300 | 163.8 | 8187.5 | -19.0 |
| Yunrui 212 | 17.0 | 5.0 | 1.5 | 14.0 | 35.4 | 496 | 83.0 | 385 | 159.3 | 7468.8 | -26.1 |
| Yunrui 3911 | 16.8 | 4.9 | 1.0 | 14.0 | 31.8 | 445 | 85.2 | 370 | 155.0 | 7750.0 | -23.3 |
| TRL3 | 16.9 | 4.6 | 1.4 | 14.0 | 36.6 | 512 | 85.1 | 290 | 127.6 | 6781.3 | -32.9 |
| Yunrui 668 | 19.2 | 4.8 | 3.0 | 14.0 | 34.8 | 487 | 81.7 | 365 | 161.9 | 8093.8 | -19.9 |
| Yunrui 108 | 17.6 | 4.9 | 2.8 | 14.8 | 27.8 | 411 | 82.5 | 340 | 135.3 | 6343.8 | -37.2 |
| Yunrui 339 | 15.4 | 4.8 | 0.4 | 15.6 | 35.0 | 546 | 81.4 | 335 | 136.5 | 7187.5 | -28.9 |
| Yunrui 62 | 18.1 | 4.6 | 0.8 | 13.6 | 37.0 | 503 | 85.8 | 355 | 161.3 | 7562.5 | -25.2 |
| Beiyu 16 ($CK_2$) | 16.8 | 5.2 | 1.5 | 16.0 | 35.4 | 566 | 85.6 | 280 | 185.6 | 9281.3 | – |

## 3 Results and analysis

**3.1 Growth traits** Crop growth and development process is an important indicator reflecting potential yield of crops, and the change in crop growth period is caused by the combined effect of crop physiological process and environmental conditions[3]. As shown in Table 1, for the test varieties, Yunrui 322 and Yunrui 102 had the longest growth period (127 d), Yunrui 212, Yunrui 108 and Yunrui 339 had the shortest growth period (117 d), and the rest of the varieties had the growth period of 118 – 126 d. The test varieties had the plant height of 230 – 295 cm. Yunrui 506 had

the greatest plant height while Yunrui 465 had the smallest plant height. The ear height was 70 – 150 cm, and the test varieties had greater ear height than the control variety Beiyu 16. Ear position ratio was 0.27 – 0.54, and reasonable ear position ratio was conducive to plant ventilation and lodging resistance. The number of productive ear per plant was 0.70 – 1.05, indicating that the double bract rate of test varieties was low. The test varieties had different degrees of grey speck disease and leaf blight resistance. TRL3 had the worst grey speck disease, reaching grade 3, and other varieties had strong grey speck disease resistance. TRL3, Yunrui 668 and Yunrui 62 had the most serious leaf blight, reaching grade 3, and other varieties had no leaf blight.

**3.2 Economic traits** As shown in Table 2, the ear length of test variety was 15.4 – 19.3 cm, and Yunrui 392 had the longest ear while Yunrui 339 had the shortest ear. The ear diameter was 4.6 – 5.2 cm, and Yunrui 465 had the largest ear diameter while Yunrui 102, Yunrui 108 and Yunrui 62 had the smallest ear diameter. The bald tip length was 0.4 – 3.0 cm, and Yunrui 668 had the longest bald tip while Yunrui 339 had the shortest bald tip. The ear row number was 12.8 – 16.4, and it was largest under CK, followed by Yunrui 465 and Yunrui 392. The number of kernels per row was 27.8 – 38.2 cm, and Yunrui 392 had the largest number while Yunrui 108 had the smallest number. The grain number per ear was 411 – 570, and Yunrui 3915 had the largest number while Yunrui 108 had the smallest number. The seed rate was 81.4 – 87.7%, and it was highest under CK, followed by Yunrui 506 and Yunrui 339. The thousand kernel weight was 280 – 385 g, and it was heaviest for Yunrui 407 while it was lightest for CK. The yield per plant was 127.6 – 190.6 g, and Yunrui 392 had the highest yield while TRL3 had the lowest yield.

**3.3 Yield** Studies of Evans[4] indicated that the length of the growth period of maize grain was closely related to yield. As apparent from Table 2, the test variety yield was 6343.8 – 10937.6 kg/ha. The yield (10937.6 kg/ha) was highest under $CK_1$, the yield was 9281.3 kg/ha under $CK_2$, and the average yield under CK was 10109.5 kg/ha. The yield of the test varieties was lower than under $CK_1$, and there were two new varieties with yield higher than under $CK_2$ (Yunrui 392, 9531.3 kg/ha; Yunrui 407, 9312.5 kg/ha), and the average yield decreased by 578.2 kg/ha (a decline of 5.7%) and 797 kg/ha (a decline of 7.9%), respectively, compared with CK. The average yield of other varieties decreased by 37.2 – 8.5% compared with CK.

## 4 Conclusions and discussions

The current environment for China's maize development is extremely complex, and there are some contradictions and problems difficult to deal with[5]. It is necessary to take into account high yield, high quality and wide adaptability in choosing fine maize varieties. Through comprehensive analysis of the test varieties, it was found that Yunrui 392, Yunrui 407 and Yunrui 7 had good comprehensive traits, good lodging resistance, stable yield and good disease resistance, and their yield (9531.3, 9312.5, 9250.0 kg/ha, respectively) was close to that of the control variety, indicating that there was large potential for yield increase, and these varieties could be widely planted in Chuxiong Prefecture to replace some varieties with low yield and poor resistance. Before mid-July 2015, the rainfall was rare in Chuxiong Prefecture, and especially in the early growth period of maize, drought brought some impact on normal growth of maize. The drought caused by rare rainfall at the early growth stage of maize might make the advantages of some varieties fail to appear, the yield of other varieties was low, and there was a need for further experimental observation to decide whether to widely plant.

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strengthen agricultural technical services and agricultural variety services and estimate the planting area of one agricultural variety in the country. The bureau of statistics should take full advantage of various types of statistical information for information services. The business administration departments should carry out timely supervision and inspection on the market services. The development and reform commission should timely intervene in the price manipulation behavior and regulate the behavior of market players. The meteorological departments should enhance weather warning in a timely manner, and reduce the blind expansion of production and price information asymmetry by multi-party cooperation and large data analysis and sharing so that production, supply and marketing are at a reasonable level.

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