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Typical Correlation Analysis between Forage Type Triticale Production Performance and Different Pilot Ecological Factors

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ABSTRACT

Domestic and foreign researches on triticale mainly focus on hereditary traits and excellent characteristics, but there are few reports on triticale yield and quality in the severe cold pastoral areas of Gansu and Qinghai. In this study, Gannong 2 triticale cultivars have been bred and planted in typical ecological areas according to the characteristics of different ecological regions. By studying the relationship between quality traits and various ecological factors, the effects of different ecological factors on the quality of Triticale hay have been clarified, which provides a reasonable basis for future triticale breeding and large-scale and targeted planting layout. The production performance and nutritional qualities of Triticale Trial in Maqu County, Gansu Province and Gannong No. 2 in Dulan County, Qinghai Province are obviously superior to other pilot sites. Through reasonable fertilization, the production performance and nutritional quality of triticale are the best. Triticale production performance is significantly related to climatic factors in different pilots. The most suitable planting area for Gannong 2 is Maqu County, Gansu Province.

1. Introduction

Animal husbandry is a pillar industry in the alpine pastoral area of the Qinghai-Tibet Plateau, and the development status of animal husbandry directly affects the living standards of the people in the pastoral area^[1]. In the past 20 years, with the impact of global warming and human activities, grassland in alpine pastures has been degraded on a large scale, and the output of forage grass has been continuously reduced, resulting in a gradual decline in

the economic development of animal husbandry in alpine pastures^[2]. Triticale has the characteristics of barren tolerance, drought tolerance, cold resistance, and disease resistance^[3]. In alpine pasturing areas with variable climates and poor water and fertilizer conditions, it can show its stable yield advantage. The yield is higher than that of rye. Elymus spike and oats^[4], so large-scale planting of forage triticale in the alpine pasturing area can just solve the problem of insufficient forage production in the alpine pasturing area. At present, researches on the nutritional

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quality of triticale at home and abroad mostly focus on genetic traits and excellent characteristics^[4-6], and there is no research on the relationship between ecological factors and the quality of triticale hay. This study first studied the production performance and nutritional quality of triticale in Different test points. Next use SPSS software to perform a correlation analysis of the ecological factors and the production performance and nutritional quality of triticale at 4 test sites, and finally clarify the effects of different ecological environmental factors on the yield and quality of triticale hay. Influence, provide a reasonable basis for future triticale breeding and large area planting.

2. Materials and Methods

2.1 Overview of the Test Site

Maqu County is affiliated to Gannan Tibetan Autonomous Prefecture in Gansu Province, located in the southwest of Gannan Tibetan Autonomous Prefecture in Gansu Province, at the eastern end of the Qinghai-Tibet Plateau, at the junction of Gansu, Qinghai, and Sichuan Provinces. Hezuo City is located in the northern part of Gannan Tibetan Autonomous Prefecture. It is of high-cold and humid type, with long cold seasons and short warm seasons. The average annual temperature is minus 0.5 °C -3.5 °C , the extreme maximum temperature is 28 °C , and the extreme minimum temperature is -23 °C . The average annual precipitation is 545 mm, concentrated in July, August and September. The cooperation area has an average frost-free period of 48 days, and the main natural disasters are frost, hail and rain. The sunshine is abundant throughout the year and the solar energy utilization rate is high. The surface runoff is 200-350 mm deep and the annual evaporation is 1222 mm.

Dulan County is located in the southeast of Haixi Mongolian-Tibetan Autonomous Prefecture in Qinghai Province. The plateau has a dry continental climate with long cold seasons and short warm seasons. The annual average temperature is 1.4-5.1 °C , the lowest extreme temperature is -29.8 °C , and the highest extreme temperature reaches 33 °C . The average annual precipitation is 179.1 mm, concentrated in June, July and August. The average altitude is 3180 m; the annual evaporation is 1358-1765 mm; and the annual sunshine hours are 2903.9-3252.5 hours.

Guide County is located in the southeast of Hainan Tibetan Autonomous Prefecture in Qinghai Province. It has a plateau continental climate with long sunshine hours and strong solar radiation. Spring is dry and windy, summer is short and cool, autumn is wet and rainy, winter is long and dry, and the temperature varies greatly from day to day. The annual average temperature is 7.2 °C , the extreme

highest temperature over the years is 34 °C , and the extremely low temperature is -23.8 °C . The annual average precipitation is 251-559 mm, the annual frost-free period is 258 days, the crop growth period is 223 days, and the annual sunshine hours are 2928 hours.

2.2 Test Materials

Main material: Gannong No. 2 triticale.

2.3 Experimental Design

The test was carried out at 4 test points in Guide (E1), Dulan (E2), Hezuo (E3) and Maqu (E4). The 4 experimental sites have the same experimental design, random block design, drilled sowing, row spacing 20 cm, sowing depth 3-5 cm, sowing amount calculated according to 7.5 million seedlings·hm⁻², 3 repeats, plot area 15 m² (5 m×3 m). Plant protection rows 1 m around the test site. No fertilizer was applied to the 4 test sites, and weeds were timely controlled during the test period.

2.4 Measurement Indicators and Methods

(1) Grass production: during the flowering period^[3]. All the above-ground parts of the plants in each plot are cut and weighed to obtain the yield of fresh grass. At the same time, 500 g were sampled and air-dried naturally to a constant weight. The yield of hay was weighed to calculate the fresh-dry ratio. Calculate the hay yield of each plot based on the fresh-dry ratio.

(2)Number of branches: before cutting during flowering period. Randomly select 1 m samples in each plot (except for the side rows), and count the number of branches with plant height higher than 50 cm in the sampling section^[3].

(3)Plant height: before cutting during flowering period. Randomly select 10 individual plants in each plot, and measure the natural height from the ground to the highest point. The average of 10 plants is used as the plant height of triticale in this area^[3].

(4)Nutritional value: Use a pulverizer to crush the dried grass samples, pass through a 1 mm sieve, randomly select 3 samples from the uniformly mixed grass samples, and measure various indicators in parallel. The content of crude protein (CP) is determined by Kjeldahl method^[7], the neutral detergent fiber (NDF) and acid detergent fiber (ADF) are analyzed by Fan's detergent fiber analysis method^[7], and the in vitro digestibility (DMD) is artificial Rumen method^[7], crude fat (EE) using Soxhlet fat extraction method^[7].

(5)Soil nutrients: The collected samples are placed in the room to air dry, the air-dried soil samples are ground, and the samples are pre-treated. The soil available nitro-

gen (AN) content is extracted by potassium chloride-flow injection analyzer Available phosphorus content (AP) adopts sodium bicarbonate extraction-molybdenum antimony colorimetric method, soil available potassium content (AK) adopts ammonium acetate extraction-flame photometer method, soil organic matter (OM) adopts potassium dichromate volumetric method, The pH value of the soil adopts the 2.5:1 water-soil ratio acidity meter method^[8].

(6)Temperature and rainfall: data comes from 2018 data from the National Meteorological Science Data Sharing Service Platform.

2.5 Data Processing

Use Microsoft Excel 2010 software to organize the test data, and then use SPSS 26.0 software to analyze and process the test data.

3. Results and Analysis

3.1 Comparison of the Production Performance Differences of Triticale in Different Pilots

Table 1. Comparison and Analysis of Production Performance of Triticale in Different Pilot Plants

Factor	Hay yield (Kg/hm ²)	Number of branches (Ten thousand branches/hm ²)	Plant height (cm)
Experiment site	10.77**	163.72**	45.75**

Note: ** indicates significant difference at the 0.01 level, and * indicates significant difference at the 0.05 level.

It can be seen from Table 1 that there are extremely significant differences in plant height, hay yield, and number of branches in different trials, and multiple comparisons are required. See Figure 1 to Figure 2 for details.

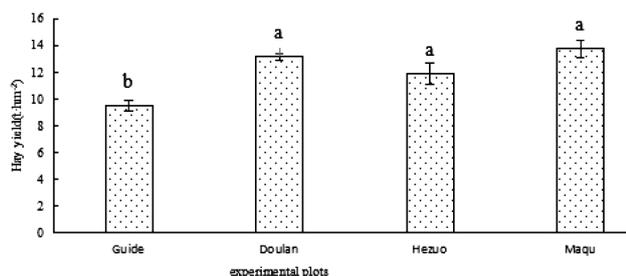


Figure 1. Multiplicity comparison of hay yield differences triticale in different experimental plots

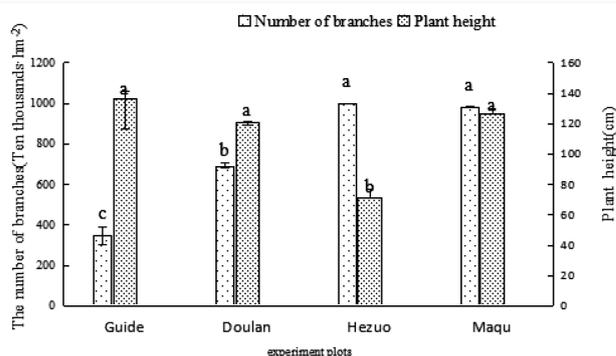


Figure 2. Comparison of the number of branches and plant height in different experimental sites

3.2 Comparison of Differences in Nutritional Quality of Triticale in Different Pilots

Table 2. Variance Analysis of Nutritional Quality of Triticale Gannong No.2 in Different Trials

Factor	CP(%)	NDF(%)	ADF(%)
Experiment site	25.34**	6.31**	4.38*

It can be seen from Table 3 that there are very significant differences in the neutral detergent fiber, acid detergent fiber and crude protein of triticale in different trials, and multiple comparisons are needed. See Figure 3 for details.

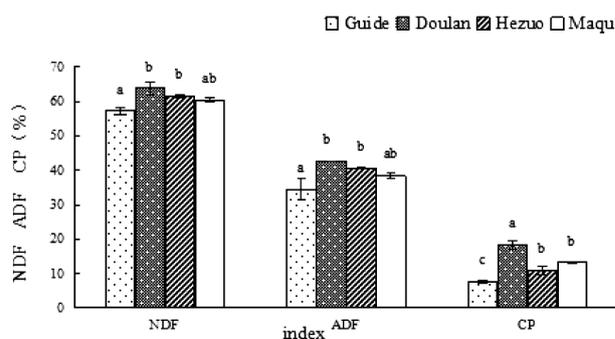


Figure 3. Difference analysis of nutrition indicators in different experimental sites

From Figure 3, it can be seen that Guide's triticale has the lowest neutral detergent fiber and acidic detergent fiber, which is not significantly different from Maqu's point, and is significantly lower than Dulan's and Hezuo's points; Dulan's triticale has the highest crude protein content. Significantly higher than the other 3 pilots, the Maqu spot's triticale protein content is second, and there is no

significant difference from the cooperation spot, which is significantly higher than the Guide spot.

3.3 Correlation between Soil Nutrients and Production Performance, Nutritional Quality of Triticale in Different Pilot Sites

Table 3. Correlation between Soil Nutrients and production performance, Nutritional Quality of Triticale in Different Pilot Sites

Factor	Plant Height (cm)	Hay yield (kg/hm ²)	Number of branches (Ten thousand branches/hm ²)	NDF(%)	ADF(%)	CP(%)
OM	0.44	0.81*	0.36	0.38	0.29	0.65
AN	-0.35	0.95**	0.76	0.92**	0.90**	0.87*
AP	0.39	0.85*	0.34	0.56	0.47	0.81*
AK	0.28	-0.83*	-0.53	-0.99**	-0.97**	-0.96**
PH	0.09	-0.47	-0.68	0.15	0.143	0.15

Note: ** indicates significant difference at the 0.01 level, and * indicates significant difference at the 0.05 level.

The canonical correlation analysis of soil nutrients, triticale production performance and nutritional quality indicators in different pilots was carried out. The results are shown in Table 3. Triticale plant height, number of branches and soil nutrients are significantly uncorrelated; Triticale hay yield is positively correlated with soil organic matter, available nitrogen, and available phosphorus, and is significantly negatively correlated with available phosphorus; neutral detergent fiber of triticale. Acid detergent fiber has a very significant positive correlation with available phosphorus, and a very significant negative correlation with available potassium; the crude protein content of triticale is significantly positively correlated with available nitrogen and available phosphorus, and has a very significant negative correlation with available potassium.

3.4 Correlation between Climate Factors and Nutritional Quality of Triticale in Different Pilot Sites

Correlation analysis of different pilot climatic factors and Gannong No. 2 triticale nutrition indicators is carried out, and the results are shown in Table 4. It can be seen from Table 4 that the hay yield of Gannong No. 2 triticale

has a significant negative correlation with the effective accumulated temperature; the number of branches of Gannong No. 2 triticale is significantly negatively correlated with the effective accumulated temperature and rainfall; the remaining Gannong No. 2 Xiaohai Wheat plant height, hay yield, acid detergent fiber, neutral detergent fiber, crude protein and other indicators are positively or negatively correlated with effective accumulated temperature and rainfall, but they are not significant.

Table 4. Correlation between Climate Factors and Nutritional Quality of Triticale in Different Pilot Sites

Factor	Plant height (cm)	Hay yield (kg/hm ²)	Number of branches (Ten thousand branches/hm ²)	NDF (%)	ADF (%)	CP (%)
Effective accumulated temperature	-0.07	-0.83*	-0.72*	-0.27	-0.24	-0.38
Rainfall	0.53	-0.50	-0.89**	-0.09	-0.15	0.09

4. Discussion

4.1 Comparison of Differences in Production Performance and Nutritional Quality of Triticale in Different Pilots

With the continuous development of herbivorous animal husbandry in my country, forage grass has gradually shown a trend of in short supply and uneven distribution [8-9]. My country's natural grassland has been declining due to long-term overgrazing and overexploitation, and the productivity of forage grass has declined sharply, which has not met the sustainable development requirements of herbivorous animal husbandry [10-11]. When a new germplasm appears, it is particularly important to play its production potential and screen out the most suitable areas for planting [3]. Based on the comparison of the production performance and nutritional value of Gannong No. 2 in different pilots, this article shows that the production performance and nutritional quality of triticale in Maqu area of Gansu Province and Dulan area of Qinghai Province are the best, and they are most suitable for Gannong No. 2 growth Area.

4.2 Correlation Analysis of Soil Nutrients in Different Pilots with Triticale Production Performance and Nutritional Quality

In order to solve the large-scale increase in forage productivity, to meet the problems of insufficient and un-

balanced forage supply in different regions. Through research, it is found that the yield of triticale hay is positively correlated with soil organic matter, available nitrogen, and available phosphorus, and has a significant negative correlation with available phosphorus; neutral detergent fiber, acid detergent fiber and available phosphorus are extremely significantly positively correlated. It is extremely significantly negatively correlated with available potassium; the crude protein content of triticale is significantly positively correlated with available nitrogen and phosphorus, and is extremely significantly negatively correlated with available potassium. Therefore, the production performance and nutritional quality of triticale can not be improved only by the amount of fertilizer, but the production performance and nutritional quality of triticale can be optimized through a reasonable amount of fertilizer. This is also basically consistent with the conclusion of the optimization screening of triticale cultivation conditions ^[12].

4.3 Correlation Analysis of Different Pilot Climatic Factors and Nutritional Quality of Triticale

The canonical correlation analysis was carried out on the climatic factors of different pilots and the nutritional indicators of Gannong No. 2 triticale. It was found that Gannong No. 2 triticale hay yield was significantly negatively correlated with the effective accumulated temperature, and the number of branches of Gannong No. 2 triticale was significantly negatively correlated with effective accumulated temperature and rainfall. This is because the production performance of triticale is significantly related to different pilot climate factors, which is basically consistent with the conclusion that the stability of production performance and ecological adaptability of different triticale genotypes are very different ^[13].

5. Conclusions

In this experiment, the plant height, hay yield, number of branches, neutral detergent fiber, acid detergent fiber, crude protein and other production performance and nutritional indicators of Gannong No. 2 triticale planted in different pilots were compared. The results showed that the production performance and nutritional quality of triticale in Maqu County of Gansu Province and Gannong No. 2 Triticale in Dulan County of Qinghai Province were significantly better than other trials.

Through the study of the correlation analysis between soil nutrients and the production performance and nutritional quality of triticale in different pilots, the production performance and nutritional quality of triticale can not be improved only by the amount of fertilizer, but by the

reasonable amount of fertilizer, the production of triticale The best performance and nutritional quality.

By studying the typical correlation analysis of different pilot climatic factors and the nutritional quality of triticale, it can be seen that the production performance of triticale is significantly related to the climatic factors of different pilots.

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