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Original Research Paper

Effects of Planting Patterns on Leaf Area Index, Ground Dry Matter and Yield of Summer Maize

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ABSTRACT

In order to probe the influence of different ridge tillage planting mode of summer maize, the study has been conducted on leaf area index, ground dry matter accumulation and yield of contrast. The results indicate that in the whole growth period of summer maize, leaf area index of ridge tillage cultivation is increased relative to that in traditional flat cultivation. The maximum difference is 0.43. Leaf area index of trapezoidal ridge tillage cultivation is higher than that of V-ridge, with the biggest difference of 0.23. Ground dry matter accumulation and yield of ridge tillage cultivation are higher than traditional flatten culture, and the planting mode of trapezoidal ridge tillage is better than V-ridge tillage. On the basis of the experimental results, it is suggested that the trapezoid ridge tillage planting of summer corn is suitable to extend widely in the western region of China.

INTRODUCTION

Ridge tillage cultivation is one of two big systems in Chinese agriculture (Guo 1992, Wu et al. 2005). It overcomes the traditional flatten culture for many unfavourable factors, makes the surface soil into wavy from plane type, increase the soil surface area; changes soil conditions such as light, heat, water, and microbial activity in environment; and improves the crop's survival of microclimatic condition so as to minimize the impact of adverse factors (Wang et al. 2005). It helps in savings of water, energy, time and work, protect the environment, improving soil fertility, water use efficiency and light energy utilization rate etc. (Xu et al. 2006, Wang et al. 2013).

The research effort on spring corn and wheat growth of ridge tillage cultivation is more, but the effect of ridge tillage cultivation under different ridge shape of summer maize growth and development has rare reports. This experiment used the method that direct seeding summer maize on the ridge after wheat harvest, to study trapezoidal ridge tillage and V-ridge tillage for cultivation of summer maize growth and yield, and to provide a theoretical basis for the summer maize ridge tillage cultivation.

MATERIALS AND METHODS

General situation: The experiment was carried out at Luoyang City Academy of Agricultural Sciences in 2010. Experiment site is situated north latitude 33°35', east longitude 111°25', located in warm temperate zone to the north subtropical transition zone and belongs to semi-humid partial dry climate, whose average temperature is 12°C-14.5°C with the average yearly rainfall of 637.1 mm. The earth for experiment was cinnamon soil and the experimental field was flat, so that is convenient for irrigation and drainage. The experiment material is Luoyu No.8, with summer seeding growth period of 98 days, compact plant type, grain intermediate type, and quality achieve to common maize level 1 grade of GB.

Test design: Irrigation ditch of ridge tillage planting maize use two forms that divide into trapezoidal and V-shaped. Trapezoidal ridge and ditch specifications are respectively 70cm and 40cm, ridge high 20 cm; V-shaped ridge and ditch specifications are respectively 70cm and 30cm, ridge high 20cm. Two lines of maize were planted on the ridge. Trapezoidal ridge maize planting density was of 52500 plants/hm^2, line spacing was 55cm, plant spacing was 34.6cm, and the plot area was 5.5m ×15m. V-shaped ridge maize planting density was of 52500 plants/hm^2, line spacing was 50cm, plant spacing was 38cm, and plot area was 5m×15m.

Manual ridging with artificial seeding was followed. Traditional flatten culture maize planting density, line spacing, plant spacing and plot area were same as with trapezoidal ridge planting method in flat sowing. Each planting mode involves three times repeat with randomized block arrangement. In whole growth period of summer maize, the total rainfall was 302.45 mm, mostly distributed in July and August, which was measured by Luoyang City Academy of Agricultural Sciences weather station. Ridge tillage fertilizing

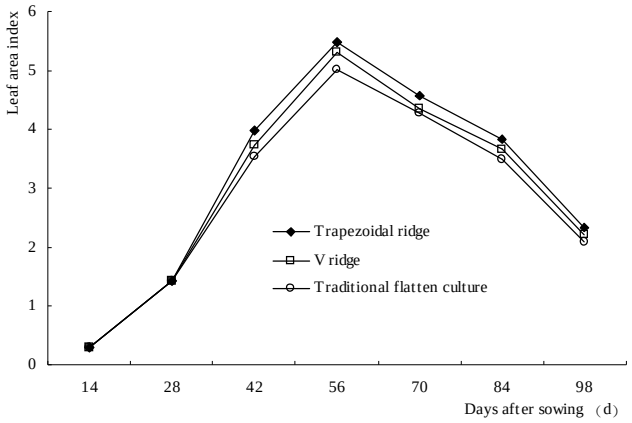

Fig. 1: Maize leaf area index change curve under different planting patterns.

and watering was all along the ditch, while traditional flatten culture fertilizing and watering use broadcast and border irrigation.

Measurement of the content and methods: Index of measurement: leaf area index, ground dry matter accumulation, yield (panicle number, grain number per panicle, 1000-grain weight, actual production). Measuring methods: leaf area index determination use drying method during summer maize growing period; determination of dry matter weight at jointing stage, large bell stage, tasseling silking stage, grouting stage and mature stage respectively. Every time two representative maize samples were taken, and according to the different growth stages were divided into stem, leaf, seed, and cob to determine the amount of dry matter accumulation. Each plot after maturity was used to calculate biological yield and grain yield that dried in the sun, and then converted to hectare yield.

RESULTS AND ANALYSIS

Effects of different planting mode on leaf area index of summer maize: Leaf area index can not only reflect the crop growth status, but also is the most important physiological parameters that to calculate crop evaporation and dry matter accumulation (Liu et al. 2004, Wang et al. 2012). In each key phase of growing season (seedling stage, jointing stage, large bell stage, tasseling stage, blossom silking stage and mature stage) leaf area index was measured in three planting modes. From Fig. 1, it is known that in the whole growth period of summer maize, the trend of leaf area index takes on increase firstly and then decrease, which reaches a maximum value at before and after blossom period. Ridge tillage leaf area index is higher than traditional flatten culture in the whole growth period; the maximum difference is 0.43, with percentage maximum of 10.7%. 14 days after sowing leaf area index does not differ much, and show that seedling stage ridge tillage and traditional flatten culture have the same growth trend. There is apparent difference after 42 days of sowing. 56 days after seeding leaf area index absolute value is increased by 0.43 (the percentage increase of 8.6%), indicating that in ridge tillage cultivation leaf area is better in this period than traditional cultivation culture. 84 days after seeding leaf area index absolute value is increased by 0.34, with percentage increase of 8.8%, showing that in ridge tillage cultivation green leaf area maintains a long time in grouting stage, more conducive to grouting mature. Among them the trapezoidal ridge culture cultivation's summer maize leaf area index is higher than that the V-shaped ridge, the biggest difference value is 0.23, showing an increase of maximum 5.78%.

Effects of different planting modes on ground dry matter of summer maize: As can be seen from Table 1, summer maize ground dry matter weight shows the same growth trend as ridge tillage. The above-ground dry matter accumulation in ridge tillage is higher than that of traditional flat cultivation in which the trapezoidal ridge tillage is higher than V-ridge tillage. Dry matter weight of ridge tillage and flatten culture reach a maximum difference value at mature period. Table 2 shows that the different treatments significantly influence dry matter accumulation at different growth stages. In the mature stage, trapezoidal ridge tillage maize panicle dry matter accounts for a larger proportion, V-ridge tillage takes the second place, and the flatten culture is the minimum. In the stalk stage flat cultivation accounts for maximum, V-ridge tillage second, and trapezoidal ridge tillage the least.

Effects of different planting modes on yield of summer maize: Table 3 shows that the three kinds of planting modes have great effect on maize yield. Ridge tillage planting mode can significantly improve the 1000-grains weight. Trapezoidal ridge tillage and V-ridge tillage yields were higher than flatten culture, and increased by 2.11% and 2.16% respectively. In trapezoid ridge tillage planting, maize panicle number, panicle length and grain number per panicle were significantly higher than those of V-ridge tillage and flatten culture. Final yield in trapezoidal ridge tillage planting mode was highest and reached 5215 kg/hm^2 showing an increase of 11.46% and 19.18% respectively over V-ridge tillage and flatten culture. Effects of different planting modes on grain number per panicle is maximum. It is the main factor that lead to the final yield differences, followed by panicle length and 1000-grain weight.

CONCLUSION AND OUTLOOK

The test results show that ridge tillage cultivation leaf area

Table 1: Different treatments of above-ground dry matter accumulation of per plant (g/plant).

Treatment	Jointing stage	Large bell stage	Tasseling stage	Grouting stage	Mature stage
Trapezoidal ridge tillage	36.66	72.73	107.49	126.60	143.17
V-ridge tillage	37.14	62.37	102.09	122.39	138.23
Flatten culture	32.68	68.32	104.77	120.75	130.99

Table 2: Different treatments of above-ground dry matter distribution per plant.

Dry matter	Trapezoidal ridge tillage		V-ridge tillage		Flatten culture	
	Dry weight (g/plant)	Percentage (%)	Dry weight (g/plant)	Percentage (%)	Dry weight (g/plant)	Percentage (%)
Leaf	27.75	19.38	29.60	21.36	27.45	20.96
Stalk	68.21	47.64	70.83	51.11	67.63	51.63
Panicle	47.22	32.98	38.14	27.52	35.91	27.41

Table 3: Yield of summer maize under different planting mode.

Treatment	Panicle number	Panicle length (cm)	Grain number per panicle (grain/panicle)	Thousand grains weight (g)	Yield (kg/hm^2)
Trapezoidal ridge tillage	29.2	17.17	522.90	186.61	5215.00
V-ridge tillage	26.8	16.93	499.62	186.71	4617.50
Flatten culture	28.2	16.28	464.18	182.67	4215.00

index of summer maize is greater than traditional flatten culture, and the highest differential value is 0.43 (% increase 10.7%). Trapezoidal ridge culture cultivation's leaf area index was higher than V-shaped ridge, the maximum difference that is 0.23, showing increase of 5.78%. Summer maize ground dry matter accumulation in trapezoidal ridge planting mode is the highest, followed by V-ridge tillage and traditional flatten culture. Summer maize yield of trapezoidal ridge tillage planting mode, compared with the V-shaped ridge and flatten culture processing, increased by 11.46% and 19.18% respectively, mainly due to significant difference in grain number per spike in the three different processing modes. The trapezoid ridge tillage planting mode of summer maize is suitable for wide popularization in the western region of China. This paper did not consider different water treatments on summer maize yield and the effect of water saving, in the future research will further improve and deepen the level of study.

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