Variation characteristics of phosphorus and potassium content in slope farmland

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Abstract. It is of great significance to study the effect of different planting patterns on the maintenance of soil nutrients in slope farmland. Compared with planting soybeans, the available phosphorus content of the 2° and 5° test fields increased by 17.89% and 21.02%, respectively, and the 3° test field decreased by 7.87%. In the experimental field for planting soybeans, the average effective potassium content decreased with the increase of slope, and the content of 0-10cm soil layer was higher than that of 10-20cm soil layer. Different planting patterns led to differences in the distribution of available phosphorus and available potassium, but the content of 0-10cm soil layer was higher than that of 10-20cm soil layer.

1. Introduction
Sloping farmland has made a huge contribution to carrying a huge population, promoting economic development, and maintaining social stability. Unreasonable development and utilization of slope farming has also brought serious soil erosion and soil quality degradation [1]. Soil erosion and the damage and loss of land resources caused by it are very serious, especially the soil erosion of sloping farmland has led to a significant reduction in soil organic matter content and soil fertility, and serious damage to land resources, which has extremely adverse effects on local economic development and ecological environment [2-3]. In order to effectively curb the further development of soil erosion, promote sustainable economic development in mountainous areas, achieve high and stable food production and improve the ecological environment, it is necessary to implement soil erosion control on slope farms [4].

Under the action of rainfall and runoff, the loss of nitrogen and phosphorus in sloping farmland not only leads to the decline of soil fertility, but also causes the eutrophication of downstream water bodies. The difference between fertilization and tillage has an important impact on runoff and loss of nitrogen and phosphorus on slope farmland [5]. In recent years, a large number of studies have reported the characteristics of runoff, sand production and nutrient loss under different fertilization and farming modes. The results show that compared with single fertilizer treatment, combined application of organic fertilizer and chemical fertilizer can reduce the risk of nitrogen and phosphorus loss [6]. Therefore, based on the surface runoff monitoring experiments under different planting modes set up at Qinling Field Monitoring Station, this paper analyzed the variation characteristics of available P and available
K contents under different slopes, in order to provide scientific guidance for reasonably determining the tillage mode and the risk of soil fertility loss of sloping farmland in mountainous and hilly areas.

2. Test design
The experimental setup is located in the Qinling Field Monitoring Center Station, which is located in Shangwang Village, Tangyu Town, Mei County, Baoji City, Shaanxi Province. This model is planned to have a total length of 64 m, a width of 18 m, and an area of 1152 m$^2$. The model has 4 main test areas, each of which is a rectangle with a length of 14 m and a width of 12 m, with slopes of 2°, 3°, and 5° respectively. Four test plots (length 12 m×width 3.5 m) are set up in each test area. The crops planted in each plot are corn, salvia, soybean, and ryegrass.

3. Results and discussion

3.1. soil available phosphorus (AP) under corn planting conditions
In the 2°, 3°, and 5° test fields, the AP content in the downslope, mid-slope, and downslope areas was higher, and the 3° test field had a higher content (Fig. 1). In the 0-10cm soil layer, the AP content of the test fields with different slopes all increased with the downward shift of the slope position. The 3° and 5° test plots had the highest AP content in the 10-20 cm soil layer in the middle slope area. In the 2° test field, the AP content in the 0-10cm soil layer on the slope and in the slope area was significantly higher than that in the 10-20cm soil layer, and there was no significant difference in the vertical distribution of AP in the underslope area. In the 3° test field, the AP content in the upper and middle slope areas increased with the increase of the soil layer, and the AP content in the 0-10 cm soil layer was higher in the lower slope area. In the 5° test field, the 0-10cm soil layer has higher AP content in different slope positions, which is 9.68%-106.22% higher than the 10-20cm soil layer, and the increase increases with the decline of the slope position.

Figure 1. Distribution characteristics of AP in experimental fields with different slope under corn planting conditions.

3.2. AP under soybeans planting conditions
Compared with planting soybeans, the AP content in the 2° and 5° test fields increased by 17.89% and 21.02%, respectively, and the 3° test field decreased by 7.87% (Fig. 2). In the 0-10cm soil layer, planting soybeans increased the AP content by 20.79% compared to planting corn, while the 10-20cm soil layer decreased by 5.92%. The AP content of the 2° test field showed that it decreased with the decrease of the slope position. The AP content of the 3° test field showed the highest AP content in the slope area, and the 5° test field showed that the AP content of the 0-10cm soil layer showed that the AP content increased with the slope position. The soil layer of 10-20cm is consistent with the change trend of the 2° test field. From a comprehensive analysis, the size distribution trend of AP content is 5°>3°>2°. In the 2° test field, the AP content of the 0-10cm soil layer increased by 22.9%-53.74% compared with the
10-20cm soil layer, and the increase rate increased with the decline of the slope position. In the 3° experimental field, the AP content of the 0-10cm soil layer increased by 28.75%-88.17% compared with the 10-20cm soil layer, with the largest increase in the slope area. The change trend of AP content in the 5° test field was consistent with that in the 2° test field, and the increase range was between 26.54% and 92.88%.

3.3. Available potassium (AK) under corn planting conditions

In the case of planting corn on sloping fields, the average AK content of 3° is the highest (155.46 mg kg⁻¹), followed by 2° (146.45 mg kg⁻¹), and 5° the smallest (142.95 mg kg⁻¹) (Fig. 3). The AK content of the 0-10 cm soil layer is between 153-165 mg kg⁻¹, which is higher than the 10-20 cm soil layer (127-151 mg kg⁻¹). In the 2° test field, the AK content in the area above the slope of the 0-10 cm soil layer is greater than that in the area under the slope. The AK content in the area above the slope of the 10-20 cm soil layer is higher, followed by the middle slope area, and the lowest content in the area under the slope. In the 3° experimental field, the AK content of the 0-10 cm soil layer increases as the slope moves down, while the 10-20 cm soil layer has the highest AK content in the middle slope area, followed by the upper slope area, and the lowest slope area. In the 5° test field, the AK content of the 0-10 cm soil layer increased with the downward slope position, and the AK content of the 10-20 cm soil layer decreased with the downward slope position.

Figure 2. Distribution characteristics of AP in experimental fields with different slope under soybeans planting conditions.

Figure 3. Distribution characteristics of AK in experimental fields with different slope under corn planting conditions.
3.4. **AK under soybeans planting conditions**

In the experimental field where soybeans were grown, the average AK content decreased with the increase of slope, and the AK content of 0-10 cm soil layer was higher than that of 10-20 cm soil layer (Fig. 4). In the 2° test field, the AK content in the upper slope area was higher, followed by the middle slope area, and the AK content in the lower slope area was the lowest. In the 3° and 5° test fields, the 0-10 cm soil layer had the highest AK content in the slope, followed by the upper slope, and the lowest content under the slope. The 10-20 cm soil layer has the same changing trend as the 0-10 cm soil layer. Compared with planting corn, the AK content of the experimental field planted with soybeans was reduced, with a decrease of 5.54% at 3° and a decrease of 2.27% in the experimental field at 5°. The 2° test field increased by 7.17%.

![Figure 4. Distribution characteristics of AK in experimental fields with different slope under soybeans planting conditions.](image)

4. **Conclusion**

Compared with planting corn, planting soybeans increased the AP content of sloping farmland to a certain extent, while the AK content decreased. Under the condition of planting corn, the contents of AK and AP in the 3° experimental field were higher, and the 0-10 cm soil layer was larger than the 10-20 cm soil layer. Under the conditions of planting soybeans, the contents of AP and AK were higher at 5° and 2°, respectively. Different planting patterns lead to differences in the distribution of AP and AK, but the content of 0-10 cm soil layer is higher than that of 10-20 cm soil layer.

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