Introduction

- Oat (Avena sativa L.) is a widely used cool-season annual forage globally. It was beneficial to cultivate forage oat in the Qinghai-Tibetan Plateau for livestock.
- The forage production was restricted by the high altitude and low temperature.
- Few studies reported the effect of different altitude to forage oat dry matter yield, this study assess to determine the effect of altitude and GDD on the forage oat production.

Methods and study sites

- The forage oat cv. Jiayan No.2 was planted at seeding rate of 90 kg ha\(^{-1}\) and row distance of 20 cm.
- This study was conducted at four sites Hezheng (2207 m), Tianzhu (2407 m), Haiyan (3042 m), and Hongyuan (3460 m) of the Qinghai-Tibetan Plateau in 2019.

Results

Table 1. The phenological period of forage oat among four sites in 2019

<table>
<thead>
<tr>
<th>Site</th>
<th>Sowing date</th>
<th>Seedling stage</th>
<th>Heading stage</th>
<th>Growth period</th>
<th>GDD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hezheng</td>
<td>24 May.</td>
<td>25 Jun.</td>
<td>07 Aug.</td>
<td>75</td>
<td>1165</td>
</tr>
<tr>
<td>Tianzhu</td>
<td>20 May.</td>
<td>24 Jun.</td>
<td>06 Aug.</td>
<td>78</td>
<td>1098</td>
</tr>
<tr>
<td>Haiyan</td>
<td>13 May.</td>
<td>30 Jun.</td>
<td>30 Jul.</td>
<td>78</td>
<td>883</td>
</tr>
<tr>
<td>Hongyuan</td>
<td>26 May.</td>
<td>05 Jul.</td>
<td>13 Aug.</td>
<td>79</td>
<td>820</td>
</tr>
</tbody>
</table>

• The growth period for heading stage at four sites was shown in Table 1. The GDD was tend to decreasing with the rising altitude (above sea level).

• Field measurements include plant height, LAI, dry matter yield, and absolute growth rate (AGR).

- The mean plant height of forage oat when the forage was mowed at heading stage. The highest mean plant height was found in Tianzhu with values of 119.5 ± 1.9 cm, which is more than that of Hezheng county, Haiyan county, Hongyuan county by 2.4% 17.7% and 102.4%, respectively.
- The mean values of LAI were 3.40 4.78 6.41 and 1.08, respectively. Haiyan county had the greatest LAI than other regions (\(p<0.05\)).
- The AGR in Hezheng, Tianzhu and Haiyan were statistically similar, but greater than that of Hongyuan (\(p<0.05\)).
- The dry matter yield of four regions were 11.95, 11.35, 11.99 and 2.17 t ha\(^{-1}\), respectively. The dry matter yield in Hongyuan was less compared to the other regions (\(p<0.05\)).

Conclusions

- This study we used absolute growth rate that account for forage oat dry matter accumulation and compared various sites with different altitude in the Qinghai-Tibetan Plateau.
- In sufficient GDD regions, oat enter the growth period ahead of schedule.
- We found that there are significant prospects to planting forage oat below the altitude of 3500 m (a.s.l) to enhance productivity.