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Research Article

Effects of cutting Schedule and intensities on the growth of alfalfa

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Abstract: The ground and underground growth of alfalfa (Algonquin) effected by different ways of mowing was studied through a pot experiment method. Mowing twice treatment possessing the average growth rate of 1.01 cm/day on the ground, this is 1.35 times of that of the control (0.43 cm/day); while cutting once 0.79 cm/day that is 84% higher than the control. At the initial stage after mowing, the ground growth rates decreased with reinforce of cutting intension but increased in the latter period instead. Moderate cutting treatments possessing significantly higher taproot length than that of light and heavy mowing, and its effect of promoting the ground biomass accumulation is very obvious. Severe mowing significantly reduced alfalfa's late ground branch number and had distinct inhibitory effect on the formation of underground biomass simultaneously. If from the point of improving the ground biomass accumulation, heavy cutting once or light cutting twice is better than light cutting once or twice cutting heavily.
Keywords: Alfalfa, mowing intensity, cutting schedule, growth of alfalfa.

INTRODUCTION

Mowing is a key link in the process of clover land management and use. From the ecological perspective, mowing is a kind of human disturbance mechanism that can affect the productivity formation and the circulation of material and energy flow of grassland community; from an economic point of view, timely and reasonable mowing is a powerful tool to realize the economic benefits of the growers. A large number of field test results show that different mowing frequency and mowing period have significant effect on the biomass yield and nutrition value of alfalfa [1-5]. Certainly, the different ways of mowing, such as the cutting tools used, the stubble height, could also affect regrowth of alfalfa and its nutrients contents [6-8]. While different alfalfa varieties have different suitable cutting period [9], this is mainly related to their regeneration characteristics [10]. In order to better understand and use cutting technology, the author adopted the way of potting to have detailed observations of alfalfa's biomass formation and growth characteristics influenced by different mowing frequency and stubble height.

MATERIALS AND METHODS

Alfalfa's establishment

The alfalfa variety used in this experiment is Aergangjin, breeded in Australia, with a TKW of 1.285g. Potted erath is loessal soil from shaanxi, the amount of organic matter and total NPK nutrient content of which were 4.5 g/kg, 0.44 g/kg, 1.40 g/kg, 17.88 g/kg; PH8.0, water content of 11. %. Each pot were filled with 10kg air-dried soil, penetrated with 2000ml water, fertilized with 3.26g urea and 6g KH_2PO_4. Yellow-green full seeds chosen, each pot holding 30-50 seeds that were evenly scattered in wet soil surface and covered by 0.5 kg dry soil, put under the canopy before emergence. Thinning was done after 20 days of alfalfa's emergency and 5 strains of plants per pot to keep. Timely watering, deinsectization and weeding, protecting its successful overwintering, started to carry on the experimental observation after the resume growth in the following year.

Mowing treatment

Mowing process including light mowing once (onceL), moderate mowing once (onceM), heavy mowing once (onceH) and light mowing twice (twiceL), moderate mowing twice (twiceM), heavy mowing twice (twiceH), plus never mowing control (CK), a total of seven processing, repeat 3 times. Mowing once was conducted in mid-may; mowing twice in the middle of April and mid-May. Light cutting stubble height 10 cm, moderate 5 cm and heavy without stubble (0 cm).

Biomass observation

Every half month measuring the height over ground to calculate daily average growth rate, counting the number of branches at the same time; Cut down biomass per pot was weighed both fresh and dried (75 ℃ for 24 hours in oven), along with the harvest

aboveground in mid-June to calculate total ground biomass. Underground biomass was obtained after the harvest of over ground in mid-June uniformly, with soil washed away and the longest length of taproot measured per basin, fresh and dried biomass weighted like the aboveground.

Data analysis

Test data by using SAS and EXCEL data processing software for statistical analysis [11].

RESULTS

For a variety of anthropic or natural disturbance, plant will actively coordinate the ground and underground organ of material and energy supply and demand balance to deal with, with each part proceeding different degrees of compensatory growth so as to show biomass accumulation variation. It is the biological basis of growers' management and application of perennial grasses by mowing, and the power source of researchers' masses of grass mowing experiments to explore the best biomass formation mechanism.

Effects of mowing methods on alfalfa's growth rate aboveground

Plant height is the most direct parameter reflecting the ground vegetation situations. This study analized the alfalfa's growth rate aboveground, which was influenced by different intensity and frequency of mowing, on the basis of regularly measuring plant height during the experimental period (table 1).

Table 1 The overground growth rate of alfalfa with different mowing treatment (cm/day)

Treatment / Time	first half of April	second half of April	first half of May	second half of May	first half of June	average of the whole duration
Once L	0.51	0.52^{D}	0.58^{E}	1.91^{A}	0.34^{E}	0.77 ^{ab}
Once M	0.64	0.44^{DE}	0.68^{D}	1.89^{A}	0.51^{D}	0.83 ^{ab}
Once H	0.62	0.46^{DE}	0.57^{E}	1.32^{C}	0.89^{B}	0.77 ^{ab}
Twice L	0.54	1.42^{A}	0.89^{C}	1.63^{B}	0.34^{E}	0.96 ^{a}
Twice M	0.69	1.28^{B}	1.24^{B}	1.27^{C}	0.67^{C}	1.03 ^{a}
Twice H	0.66	0.92^{C}	1.69^{A}	0.74^{D}	1.22^{A}	1.05 ^{a}
CK	0.61	0.40^{E}	0.61^{DE}	0.45^{E}	0.07^{F}	0.43 ^{b}

***Different letters in the same colum mean significant differences at P≤0.05 or highly significant differences at P≤0.01(the capital form).**

Concluded from the average growth rate within whole experiment period, mowing processing significantly promote the growth of alfalfa over ground. Mowing twice treatment possessing the average growth rate of 1.01 cm/day on the ground, this is 1.35 times of that of the control (0.43 cm/day); while cutting once 0.79 cm/day that is 84% higher than the control.

By contrasting the average growth rates in different periods after mowing, it can be found that extremely significant differences exist in the alfalfa's over ground growth because of the way of mowing. Every time after mowing there had been significantly stimulation on the growth of alfalfa overgroud. But different mowing intensity had different affecting performance in different periods: for both mowing twice and mowing once, the ground growth rates decreased with reinforce of mowing intension in the early stage after cutting, but increased in the latter period instead.

Effects of mowing methods on alfalfa's root length underground

Alfalfa is a kind of typical deep-root legume forage that can make good use of the deep soil water and nutrient resources. In the arid region of loess plateau its root elongation rate can reach 1 m per year [12]. Potted case with depth and space restrictions, alfalfa's root elongation is bound to be affected. Then whether will it be influenced by the way of mowing? The experimental results (Fig.1) show that mowing is also helpful for alfalfa's root elongation. But there was no significant difference between the two mowing frequency, the main effect was coming from cutting intensity. In both of the two mowing frequency, taproot lengths of the moderate cutting processings were significantly higher than that of the light and heavy mowings.

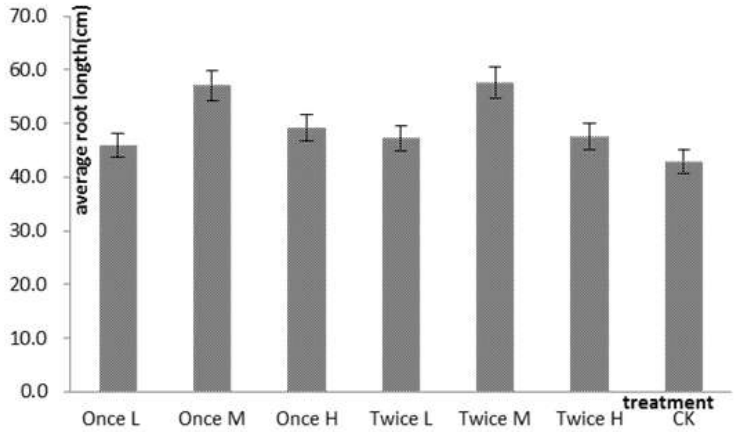

Fig. 1 Average taproot longth of alfalfa with different mowing treatment

Effects of mowing methods on alfalfa's branch numbers overground

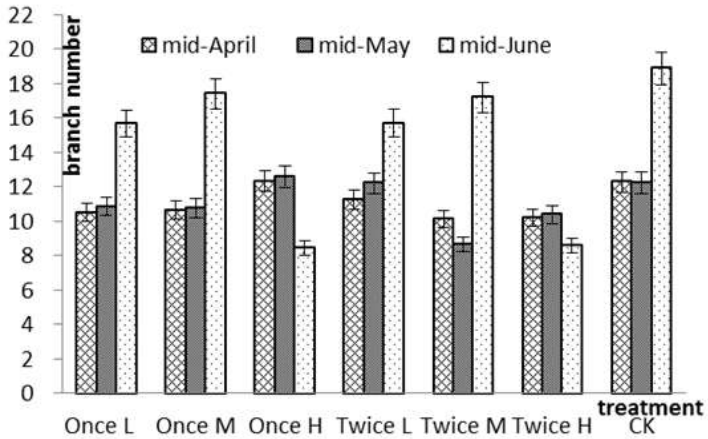

Fig. 2 Branch development of alfalfa with different mowing treatment

Augment branchs is alfalfa's another expression of growth on the ground. Observations of branch number at different times (Fig.2) showed that mowing will reduce alfalfa's branch number in the late growth period. When harvested in mid-june, the heavy mowing processings of both cutting frequency had less than half of branch numbers contrasted with the control treatment; and the branch numbers of the light and moderate mowings of both were significantly lower without obvious difference one another.

Effects of mowing methods on alfalfa's biomass accumulation over and under ground

Different ways of cradles had a significant effect on the ground and underground biomass formation or accumulation of alfalfa. As shown in figure 3, all the total biomass of the cutting processings were higher than that of the control. But the ground and underground performances were on the contrary, with underground biomass accumulation less than that of the control while the ground higher than control.

For the mowing intensity effect, that of the moderate cutting on aboveground biomass accumulation was most obvious. The ground biomass of the moderate mowing once was 1.60 times of that of the cntral, and that of the moderate mowing twice was 1.66 times. While heavy mowing inhibitory effects on the formation of underground biomass were significant. Once severe mowing and severely mowing twice reduced underground biomass 16% and 40% respectively.

From the point of mowing frequency influence, mowing twice had a bigger impact on the underground biomass accumulation than to cut once, while the impacts on the ground biomass formation were more complex: heavy cutting once or light cutting twice had better effect than light mowing once or heavily cutting twice.

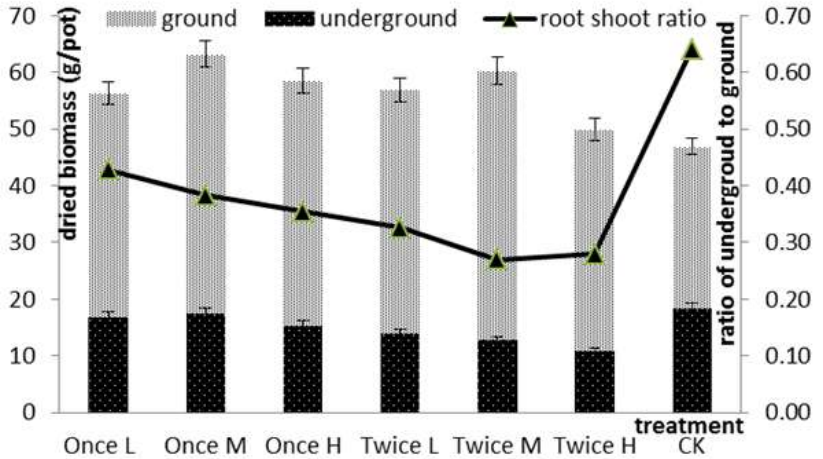

Fig. 3 Total dried biomass of alfalfa with different mowing treatment

Overall, moderate mowing is beneficial to increase alfalfa's ground biomass accumulation; multi-frequency, more severe mowing against underground biomass formation. This combination of results was also reflected in the performence of alfalfa's root shoot ratio. The root shoot ratios of cutting processings decreased with the aggrandization of mowing frequency and intensity, contrasted to that of the control.

CONCLUSIONS

Cradles of alfalfa will affect both the ground and underground growth, but different mowing ways mainly diverging in frequency and stubble height have imparity affect effects. Both mowing once and twice accelerated ground height elongation rate of alfalfa, but the twice cradles effect is greater than the once. And the two cutting frequencies presented a same rule: at the initial stage after mowing, the ground growth rates decreased with reinforce of cutting intension but increased in the latter period instead. All mowing ways reduced alfalfa's branch number in the late growth period, and the heavy cuttings' influences were extremely significant. But there was no significant difference between mowing frequencies. All cutting ways promoted root elongation of alfalfa and the moderate mowing processing had the most outstanding effect, but there was no significant difference between mowing frequencies. Each mowing way had positive impact on the total biomass formation or accumulation of alfalfa. But this was mainly attributed to the contribution of above ground growth; underground biomass accumulation is influenced by mowing inhibition. Increasing the mowing frequency and intensity significantly decreased the root-shoot ratio of alfalfa. If from the point of improving the ground biomass accumulation, heavy cutting once or light cutting twice is better than light cutting once or twice cutting heavily.

Acknowledgements

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