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Over ground and Underground Development of Alfalfa in Establishment Period

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Abstract: The characteristics of the over ground and underground growth of Algonquin alfalfa were observed and analyzed through a pot experiment method. The results showed that under the condition of sufficient water and fertilizer, alfalfa on the ground and underground biomass during the planting period continues to accumulate. In this process, the cumulative speed and amount on the ground was superior to the underground: The average ground biomass cumulative speed was 8.8 times of the underground; at the mowing before winter, on the ground and underground dried biomass per plant was 0.51 g and 0.18 g respectively. Alfalfa's length development was closely related to the daily average temperature change over time. The largest plant height growth rate on the ground was corresponding to a daily average temperature of 23.69 ℃, while that of the underground root length's was 15.49 ℃.
Keywords: Alfalfa, Establishment period, Overground growth, Underground growth

INTRODUCTION

To alfalfa, worldwide excellent leguminous forage, so many aspects of research about its formation law, adaptability and resistance to environment, variety breeding, mowing management and so on are prevalent [1-6]. But all these subsequent research and application of alfalfa are on basis of its successful planting establishment, which makes it significant to explore the growth rule and influencing factors in this period. The establishment phase is the period between seedling emergences and first harvest [7].The ground plant height growth and biomass accumulation in alfalfa planting stage reflect its ability to utilize light resources and the immediate economic benefits; the accumulation of underground biomass and root elongation and extension is alfalfa's ability to possession and use of water and soil resources and the foundation to live through the winter. In view of this, the author observed and recorded the ground and underground growth and biomass formation and cumulative distribution under the condition of sufficient water and fertilizer.

MATERIALS AND METHODS

Experimental materials

♣ Alfalfa: Aergangjin breeded in Australia with a TKW of 1.285g.

♣ Potting earth: Loessal soil from Shaanxi province, with the basic nutrients and moisture listed in table1:

Table 1: The basic nutrients and moisture of potting earth

Organic matter (g/kg)	Total nitrogen (g/kg)	Total phosphorus (g/kg)	Total potassium (g/kg)	Available nitrogen (mg/kg)	Available phosphorus (P_2O_5) (mg/kg)	Available potassium (K_2O) (mg/kg)	pH	Moisture (H_2O) (%)
4.5	0.44	1.40	17.88	36.0	1.79	118	8.0	11.15

Experimental methods

♣ Potting : 12 pots in total, each pot were filled with 10kg air-dried soil, penetrated with 2000ml water, fertilized with 3.26g urea and 6g KH_2PO_4.

♣ Seeding : Yellow-green full seeds were choose, 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 for alfalfa's emergency and 5 strains of plants per pot to keep.

♣ Growth observation: Alfalfa plants on the ground and underground biomass were determined four times every period. Every time determined three pots randomly, with the ground part grazing mowing and the main plant height measured, branch number counted, fresh weight and dry weight (50℃ for 24 hours) obtained; Underground partial soil were washed away by water and the length of taproot, fresh and dry weight were measured also. All items were calculated for the average individual per pot.

RESULTS

The ground and underground growth accumulation

The experiment lasting 104 days, started with the potting on July 4, sowing seeds on July 11, emergencing on July 14, first mesuring on August 4, till the end cutting of October 26. Sorts through four measurements the ground and underground growth results are shown in figure 1.

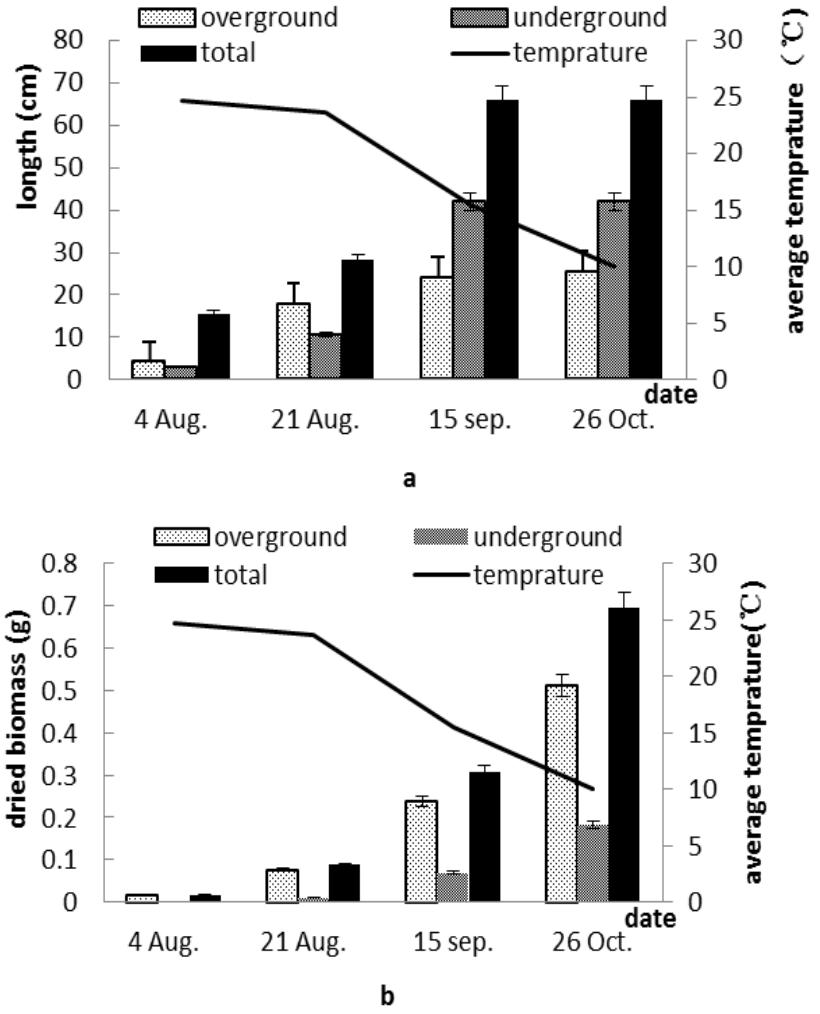

Fig 1: The ground and underground growth of alfalfa in establishment period
("a" represents plant longth development; "b" represents plant biomass accumulation)

At the end of experiment, the total plant length was 65 cm on average, with an average height of 40 cm for ground, and an average 25 cm for underground (a). Both the ground and underground ceased growing in September 15 in the rough. The first phase was given priority to the ground growing, while in the later period it was the underground plant length that born more than the part on the ground. But for the individual plant biomass accumulation (b), the ground and underground both continued to grow in the whole period of alfalfa planting establishment while the early growth speed is very slow compared with the middle and later period of growth, which account for 89% and 96% of their total amounts respeativly. Because the experiment was conducted in outdoor, and the effects of control is consistent, the biggest impact was the temperature condition. It is generally believed that for alfalfa planting period the best temperature range is 15-24 ℃ [7].In this experiment the daily average temperature were below 15 ℃ since September 15th, and the plant height growth is sensitive to this temperature change.

The ground and underground growth rate change

The rate of plant growth and biomass accumulation of alfalfa in this plangting stage was calculated and analyzed (figure 2). The maximum growth rate of plant height on the ground (0.8 cm per day) appeared in the middle of August, while that of underground (1.2 cm per day) in the middle of September. This caused two obvious inflection points occur on the plant total length elongation changing over time (a). It can be concluded that alfalfa's growth strategy in tne construction period is to rapidly grow on the ground first, striving to make full use of energy resources, and then accelerate the growth of underground to absorb more soil water and nutrient.

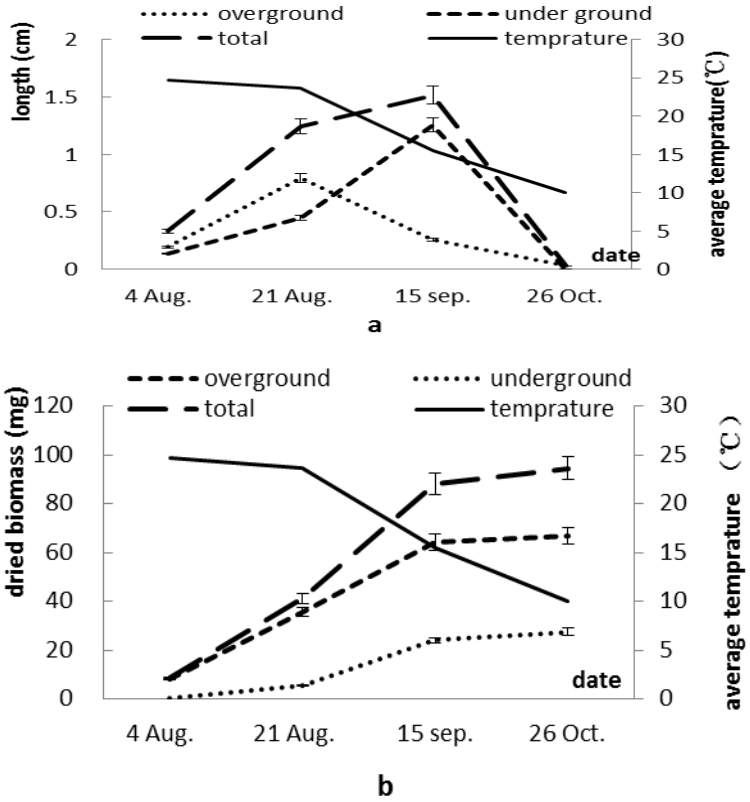

Fig- 2 : The ground and underground growth rate change

(“a” represents plant longth development rate; “b” represents plant biomass accumulation rate)

Although underground elongation rate rapidly increased in September, far higher than the ground’s, in the context of biomass accumulation rate, it was on the ground that has been on the advantage in the whole period of planting with the average 8.8 times of the underground biomass accumulation rate (b). It was not contradicting of this growing regularity of alfalfa. Its growth didn't stop on the ground, in spite of the decrease of plant growth rate in late August with the temperature down, with the branch on the rising, that till the mowing on October 26 before winter there were an average level of main branch 3 and secondary 6. Similarly as underground root elongation rate drops rapidly from mid-september, the secendary root and total root biomass were still growing. Many research results have shown that the underground biomass accumulation has no correlation with taproot longth[8-10].

Growth comparation of overground to underground

It can be seen from the front result that dry matter growth and plant length elongation of alfalfa planting in construction period of the ground and underground have different laws.

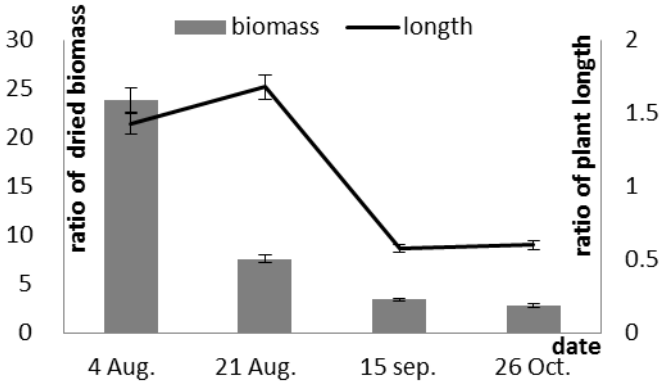

Fig-3: The plant longth and biomass ratios of overground to underground

Comparing each phase observations of the two type growth of the two parts (figure 3), it is clear that the plant height(length) ratio of over ground to underground is greater than 1, i.e. the overground grows faster than underground before September while the reverse is true later. On the other hand, the biomass ratio of aboveground to underground declined on with time and climate change, but the minimum (in October when mowing) value is 2.42, and the maximum is 23.84, which means the dry matter accumulation on the ground has alwayes been higher than the underground.

CONCLUSIONS

Alfalfa's dry matter growth and plant length elongation of over ground and underground has different laws in establishment period under the condition of sufficient water and fertilizer. Both over ground and underground biomass during this period continued accumulating, but the former was superior to the later in speed and amount. The average biomass cumulative speed on the ground was 8.8 times of the underground; To the time of mowing before winter the ground and underground biomass per plant was 0.51 g and 0.18 g respectively, among which that of over ground accounted for 73.6% of the total plant biomass.

Alfalfa's plant length(height) growth is closely related to the daily average temperature over time. The largest plant height growth rate on the ground was corresponding to a daily average temperature of 23.69 ℃, while that of the underground root length's was 15.49 ℃. This is consistent with the report of Pu Jinhong [11],that alfalfa root growth's fastest time is in autumn and winter season, when the overground growing stops or slows down; while the branches and leaves most exuberant growth period is its slowest growing period.

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