

# 刈割对苜蓿人工草地昆虫群落结构及动态的影响

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**摘要:**运用物种丰富度( $S$ )、个体数量( $N$ )、申农指数(Shannon's index,  $H'$ )、均匀度指数( $E$ )作为多样性分析的综合指标, 分析了不同刈割次数苜蓿人工草地昆虫的群落结构和季节动态。结果表明, 刈割对群落物种丰富度的影响主要是部分稀有害虫种类, 对优势种和常见种的影响较小。随着刈割次数的增加, 害虫的物种丰富度下降。刈割对天敌的种类及数量影响较小, 其影响主要发生在刈割初期。苜蓿人工草地昆虫各类群落的多样性和均匀度指标在时间过程中的变化呈明显的差异和规律性, 且受刈割次数的影响较大。当 6 月上旬苜蓿进入现蕾末期和开花初期时, 正值害虫始盛期, 蚜虫、蓟马、盲蝽等优势类群的虫口数量很大, 总群落和害虫亚群落的多样性和均匀度均很低, 此时刈割, 可以有效地降低优势害虫类群的虫口数量, 提高各类群落的多样性和均匀度, 增强天敌的自然控制能力, 使第 2 茬苜蓿的害虫数量一直保持在较低的水平。在苜蓿种子生产田, 当 6 月上旬害虫进入始盛期后, 数量开始急速增长, 是防治的关键时期。

**关键词:**苜蓿; 昆虫群落; 多样性; 刈割

## Cutting effects on the insect community structure and dynamics of alfalfa pasture

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**Abstract:** Cutting is an important measure in maintaining alfalfa pasture. Choice of times and intervals for cutting directly affect the insect community composition and dynamics. The seasonal dynamics of insect communities on alfalfa pasture were investigated with biodiversity measures including species richness ( $S$ ), unit numbers ( $N$ ), Shannon's Index ( $H'$ ), and evenness ( $E$ ). The results showed that, in terms of species richness of the community, cutting influenced some rare species of insect pests rather than dominating and common species. Species richness of insect reduced with increase in cutting times. On the other hand, cutting had little effect on the species and populations of natural enemies due to their shifting from alfalfa plants to other crops nearby or dropping on the ground during cutting. In fact, the study showed that the populations of natural enemies can reach comparatively high density level from an initial low level after cutting because of their faster population growth than insect pests. Both the diversity and evenness of insect communities varied significantly and with regularity over time and were affected a lot by the number of cutting times. The populations of some dominant pests such as aphids, thrips, and alfalfa plant bugs began to boom when alfalfa plants changed from budding blossoming in the first ten-day period of June. It is suggested to cut at this time because both the diversity and evenness of the over an insect community and insect pests sub-communities are at low levels. Cutting in this period can effectively reduce the populations of dominant insect

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pests, and at the same time, increase insect community diversity and evenness to strengthen the insect pest control by natural enemies, and therefore restrain the populations of insect pests at low levels during the second crop. For alfalfa seed production fields, low temperature slowed the growth of pest populations before mid-May. After that, rising temperature sped up the growth of pest numbers, which attained higher levels than the slower increasing natural enemies. As mentioned above, the best moment to control insect pests populations could be the period in the first ten days of June, because measures employed to control pests in this period were not only effective to reduce pest populations, but also helpful to protect natural enemies and improve the quality of alfalfa seed.

**Key words:**alfalfa; insect community; diversity; cutting

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昆虫群落与赖以生存的植物群落之间有着极其密切的联系,植物群落的组成及变化决定着昆虫群落的特征,反映出植物与昆虫群落相互作用的效应。

苜蓿由于其多年生、枝叶茂盛、营养价值高等生物学特性,为昆虫提供了一个相对稳定、适宜的生存环境,被誉为“昆虫资源库”。刈割是苜蓿人工草地耕作制度中的一项重要措施。刈割的时间和次数不仅影响苜蓿草产品的质量、产量和利用年限,也极大地影响着昆虫群落的组成和动态。研究刈割对苜蓿人工草地昆虫群落结构和动态的影响规律有助于了解在时间变化过程中节肢动物群落的发生发展规律,揭示群落内复杂的种间关系及寄主物候期和环境因子的影响,以便制定害虫的防治对策。

我国北方苜蓿种植地中有节肢动物 300 种以上<sup>[1~7]</sup>,极大地影响了苜蓿的产量和质量<sup>[8~12]</sup>。以往国内外对苜蓿主要害虫和天敌及传粉昆虫进行过比较广泛的研究,但多数限于单种种群<sup>[13~16]</sup>或节肢动物群落<sup>[17~22]</sup>随时间序列而变化的报道。为了分析刈割对苜蓿人工草地昆虫群落结构和动态的影响规律,以期对苜蓿人工草地害虫管理的理论和实践提供依据,在甘肃省兰州市选择了不同刈割次数的苜蓿人工草地进行了调查研究。

## 1 调查研究方法

### 1.1 调查方法

选择 3 块 3~4 年生的紫花苜蓿(*Medicago sativa*)人工草地,分别进行刈割 1 次(6 月 2 日)、刈割 2 次(6 月 2 日和 7 月 12 日)和不刈割(种子田)处理。从 4 月中旬至 8 月下旬,每隔 10d 左右调查 1 次,每次每处理随机选择 15 个样点,每点用捕虫网(口径 33cm)扫描 10 单网(摆幅 180°),同时调查 1m×1m 以内的地表节肢动物(包括昆虫和蜘蛛),统计 15 个样点的全部种类和数量。田间不能识别的种类编号,带回室内鉴定。

### 1.2 分析方法

群落参数采用物种丰富度  $S$ =种类数,多样性指数  $H' = - \sum p_i \log_2 p_i$  (其中  $p_i$  为第  $i$  种个体数占总个体数的比例),均匀度  $E = H' / \log_2 S$  表示<sup>[22~25]</sup>。

## 2 结果

### 2.1 刈割对昆虫群落物种丰富度的影响

经田间系统调查,共采集节肢动物(包括昆虫和蜘蛛)49 种类(部分昆虫按科、蜘蛛按目统计),分属于 11 目。其中鞘翅目 12 种,双翅目 9 种,半翅目 7 种,膜翅目 6 种,鳞翅目 5 种,同翅目 4 种,其它种类分属缨翅目、直翅目、脉翅目、螳螂目和蜘蛛目。害虫有 27 种,天敌 17 种,传粉蜜蜂 2 种,其余为腐生或吸血昆虫。

刈割对群落物种丰富度的影响主要是部分稀有害虫种类,对优势种和常见种影响较小。随着刈割次数的增加,害虫的物种丰富度下降(表 1),未刈割、刈割 1 次和刈割 2 次的害虫丰富度依次为 27 种、24 种和 21 种。但刈割对天敌种类的影响较小,且主要发生在刈割初期。这主要是因为刈割时大多数天敌起飞转移或掉落地上,待苜蓿长出后又很快迁回植株上的原故。

### 2.2 刈割对昆虫群落个体数量的影响

从图 1 中可以看出,3 种处理中总群落的个体数量消长曲线与害虫亚群落的消长曲线基本一致。这说明群落中个体数量的变化趋势主要受害虫亚群落的影响。在害虫亚群落中,优势种类主要有蚜虫、蓟马和盲蝽,它们的数量变化极大地影响着害虫亚群落和总群落的数量消长,其中蚜虫主要是苜蓿彩斑蚜 *Therioaphis* sp. 和苜蓿无网蚜 *Acyrtosiphon kondoi* Shinji et Kondo, 可为害苜蓿的幼芽、嫩茎和叶片,繁殖极快,给苜蓿生产造成较大威胁;蓟马和盲蝽主要包括烟蓟马 *Thrips taaci* Lindeman、苜蓿盲蝽 *Adelphocoris lineolatus* (Goeze)、牧草盲蝽 *Lygus pratensis* Linnaeus 等,可为害花器各部,常造成落花,影响苜蓿种子产量。

在未刈割地方数据以前,苜蓿处于分枝期,由于气温较低,害虫数量增长缓慢,种群数量很少;5 月中旬以后,害虫数量增长逐渐加快,到 6 月上旬苜蓿进入现蕾末期和开花初期时,害虫数量开始急速增长,到 6 月下旬苜蓿进入开花盛期时达到高峰。此

表 1 刈割对昆虫群落丰富度的影响

| 日期<br>Date | 未刈割地 No cutting |             |                       | 刈割 1 次 Cutting one time |             |                       | 刈割 2 次 Cutting two times |             |                       |
|------------|-----------------|-------------|-----------------------|-------------------------|-------------|-----------------------|--------------------------|-------------|-----------------------|
|            | 总群落<br>Total    | 害虫<br>Pests | 天敌<br>Natural enemies | 总群落<br>Total            | 害虫<br>Pests | 天敌<br>Natural enemies | 总群落<br>Total             | 害虫<br>Pests | 天敌<br>Natural enemies |
| 04-17      | 21              | 14          | 7                     | 17                      | 12          | 5                     | 14                       | 11          | 3                     |
| 04-27      | 23              | 17          | 6                     | 22                      | 16          | 6                     | 20                       | 13          | 7                     |
| 05-07      | 26              | 19          | 7                     | 25                      | 18          | 7                     | 26                       | 18          | 8                     |
| 05-16      | 25              | 17          | 8                     | 24                      | 16          | 8                     | 27                       | 18          | 9                     |
| 05-26      | 30              | 17          | 12                    | 30                      | 17          | 12                    | 32                       | 20          | 11                    |
| 06-05      | 33              | 21          | 10                    | 16                      | 12          | 3                     | 18                       | 13          | 4                     |
| 06-18      | 31              | 20          | 9                     | 27                      | 17          | 9                     | 28                       | 18          | 9                     |
| 06-26      | 37              | 21          | 14                    | 37                      | 22          | 14                    | 37                       | 22          | 14                    |
| 07-06      | 39              | 22          | 15                    | 35                      | 20          | 14                    | 37                       | 21          | 15                    |
| 07-19      | 32              | 17          | 13                    | 25                      | 14          | 10                    | 13                       | 9           | 3                     |
| 07-26      | 35              | 20          | 12                    | 21                      | 12          | 9                     | 17                       | 11          | 6                     |
| 08-06      | 38              | 23          | 13                    | 33                      | 18          | 12                    | 30                       | 17          | 12                    |
| 08-16      | 29              | 15          | 12                    | 26                      | 17          | 7                     | 25                       | 16          | 9                     |
| 08-26      | 28              | 18          | 9                     | 26                      | 17          | 7                     | 25                       | 17          | 8                     |
| 合计 Total   | 49              | 27          | 17                    | 44                      | 24          | 16                    | 40                       | 21          | 16                    |

后虽然由于天敌的控制作用增强使害虫数量有所下降,但仍然维持在很高的水平上。到 7 月底苜蓿进入成熟期以后,由于苜蓿枝叶已枯老,加上天敌的控制作用,害虫数量急剧下降到低水平。

刈割对害虫数量消长影响很大(图 1),在害虫始盛期刈割 1 次,可以有效地降低蚜虫、蓟马、盲蝽等优势类群的虫口基数,使第 2 茬苜蓿的虫口数量一直保持在较低的水平,其高峰期害虫亚群落的虫口数量为 1334 头,只有未割地高峰期害虫数量(4398 头)的 30.33%;在第 2 茬苜蓿害虫发生高峰期进行第 2 次刈割,其第 3 茬苜蓿害虫高峰期的虫口数量只有 863 头,是未割地害虫数量的 19.62%。

刈割对天敌的影响比对害虫的影响小,虽然刈割初期天敌的数量很少,但其增长速度相对比害虫快,很快就能达到较高的密度水平。在 6 月初害虫始盛期刈割 1 次,其天敌在高峰期时的虫口数量为 491 头,是未割地天敌数量(802 头)的 61.22%;在第 2 茬苜蓿害虫发生高峰期进行第 2 次刈割,其第 3 茬苜蓿害虫天敌在高峰期的虫口数量有 279 头,是未割地天敌数量的 34.79%。

2.3 刈割对昆虫群落多样性和均匀性的影响

从图 2、图 3 中可以看出,苜蓿人工草地昆虫各类群落的多样性和均匀度指标在时间过程中的变化呈明显的差异和规律性,且受刈割次数的影响较大。在刈割之前,各处理在同一群落中的多样性和均匀度指标的变化趋势相似。在 4 月底,由于总群落和害虫亚群落的物种数已明显增多,而优势物种的数量相对较少,因此其多样性和均匀度指标均较高;而此期天敌亚群落的物种数很少,因此多样性指数较低。6 月初苜蓿第 1 次刈割以后,由于降低了蚜虫、蓟马、盲蝽等优势类群的虫口数量,使总群落和害虫亚群落的多样性和均匀度指标均比未割地高;天敌亚群落的变化趋势与总群落和害虫亚群落相似,但由于刈割初期天敌亚群落的物种数减少,因此多样性指数较低。

3 讨论

刈割既是苜蓿生产中的一重要措施,也是控制害虫为害的一条有效途径。一般孕蕾期刈割的苜蓿营养物质含量最高,开

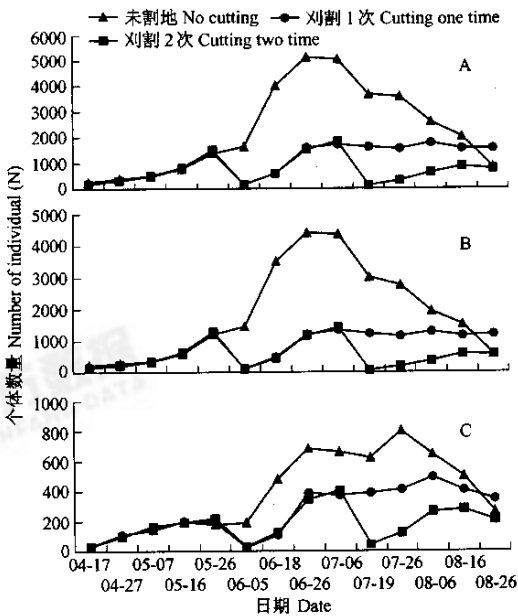


图 1 刈割对昆虫总群落(A)、害虫亚群落(B)和天敌亚群落(C)个体数量的影响

Fig. 1 The effect of cutting on number of individual of insect communities(A), pest insects(B) and natural enemies(C)

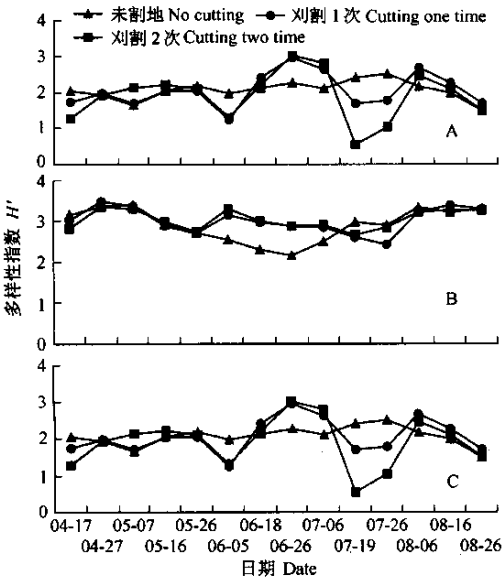


图2 刈割对昆虫总群落(A)、害虫亚群落(B)和天敌亚群落(C)多样性指数的影响

Fig. 2 The effect of cutting on diversity of insect communities(A), pest insects(B) and natural enemies(C)

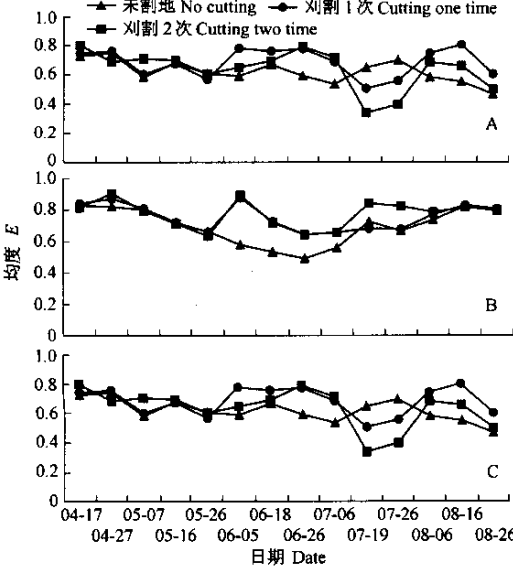


图3 刈割对昆虫总群落(A)、害虫亚群落(B)和天敌亚群落(C)均匀度的影响

Fig. 3 The effect of cutting on evenness of insect communities(A), pest insects(B) and natural enemies(C)

花盛期刈割可以获得最高牧草产量和保持持久利用的年限<sup>①</sup>。当苜蓿进入现蕾末期和开花初期时,正值害虫始盛期,蚜虫、蓟马、盲蝽等优势类群的虫口数量很大,总群落和害虫亚群落的多样性和均匀度均很低,此时刈割,不但苜蓿的营养价值和产量高,而且可以有效地降低优势害虫类群的虫口数量,提高各类群落的多样性和均匀度,使第2茬苜蓿的害虫数量一直保持在较低的水平。

苜蓿地中的天敌主要有蜘蛛、瓢虫、食虫螨、草蛉、寄生蜂等,苜蓿刈割时大多迁移至其它作物或掉落到地上,待苜蓿长出后很快又转到苜蓿上。因此,刈割对天敌的影响较小,虽然刈割初期天敌的数量很少,但其增长速度相对比害虫快,很快就能达到较高的密度水平。

在苜蓿种子生产田,5月中旬以前,由于气温较低,害虫数量增长缓慢,种群数量很少;5月中旬以后,随着气温的上升,害虫数量增长逐渐加快,但天敌增长缓慢,天敌的自然控制能力较差,到6月上旬苜蓿进入现蕾末期和开花初期时,害虫进入始盛期,数量开始急速增长,此时是防治的关键时期,不但可以有效地控制害虫的为害,提高苜蓿种子的产量和质量,而且对天敌的影响较小。因此,应加强此期的测报工作,对达到防治指标的应采取相应的防治措施。

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