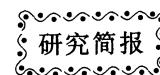


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## 控释氮肥对棉花纤维品质、产量及氮肥利用效率的影响

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**摘 要:** 设计 100% 树脂包膜尿素基施、50% 普通尿素+50% 树脂包膜尿素基施和棉花专用肥基施 3 种控释氮肥处理, 以 100% 普通尿素为对照, 研究等氮条件下, 不同控释氮肥处理对棉花(鲁棉研 28)不同开花期棉铃纤维品质、产量及氮肥利用效率的影响。结果表明, 与对照相比, 100% 树脂包膜尿素处理 7 月下旬棉铃纤维比强度和 8 月中、下旬棉铃纤维马克隆值显著增大, 7 月下旬棉铃纤维成熟度显著增加, 籽棉产量和皮棉产量分别增加 6.2% 和 6.4%, 偏生产力与农学效率均达极显著差异; 棉花控释专用肥处理棉花生育中、后期棉纤维长度、比强度和马克隆值显著增大, 成熟度显著增加, 籽棉产量和皮棉产量分别增加 5.0% 和 4.3%, 偏生产力和农学效率达显著或极显著差异; 而 50% 普通尿素+50% 树脂包膜尿素处理仅 7 月下旬棉铃纤维比强度和 8 月中旬棉铃纤维马克隆值显著增大, 8 月中旬棉铃纤维成熟度显著增加。上述结果表明, 100% 树脂包膜尿素处理增产效果最显著, 氮肥利用效率最高, 而棉花专用肥处理纤维品质较优。

**关键词:** 棉花; 控释氮肥; 开花期; 纤维品质; 氮肥利用效率

## Effects of Controlled Release Nitrogen Fertilizer on Fiber Quality, Yield, and Nitrogen Use Efficiency

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**Abstract:** Controlled release fertilizers are paid attention because of their high efficiency. However, there is little information in the effect of controlled release nitrogen fertilizer on cotton fiber quality. The objective of this study was to evaluate the differences between plain urea and controlled release urea. Cotton cultivar Lumianyan 28 was grown under field conditions with three types of controlled release nitrogen fertilizers, including 100% pitch coated urea (PCU), 50% plain urea (PU)+50% pitch coated urea (PCU), and 100% controlled release bulk blending fertilizer (CRBBF). The results indicated that fiber strength of 100% PCU treatment was enhanced on 21 to 31 July compared with CK<sub>2</sub>, fiber micronaire on 11 to 31 Aug. was augmented, fiber maturity on 21 to 31 July was improved. The seed cotton yield and lint cotton yield of 100% PCU treatment were increased by 6.2% and 6.4%, and those of PFP<sub>N</sub> and AE<sub>N</sub> were significantly enhanced. For 100% CRBBF treatment, fiber length was increased on 21 to 31 Aug., fiber strength was enhanced on 21 to 31 July and 21 to 31 Aug., fiber micronaire was augmented on 1 to 31 Aug., and fiber maturity was improved on 1 to 20 Aug.. The seed cotton yield and lint cotton yield of CRBBF treatment were increased by 5.0% and 4.3%, respectively, and those of PFP<sub>N</sub> and AE<sub>N</sub> were also significantly enhanced. For 50% PU+50% PCU treatment, fiber strength was enhanced on 21 to 31 July, micronaire was augmented on 11 to 20 Aug., fiber maturity was improved on 11 to 20 Aug. But there were no obvious differences on yield and nitrogen use efficiency between 50% PU+50% PCU treatment and CK<sub>2</sub>. In conclusion, 100% PCU treatment has the most obvious effect on yield and nitrogen use efficiency, while 100% CRBBF treatment could be better to improve fiber quality.

**Keywords:** Cotton; Controlled release nitrogen fertilizer; Blooming date; Fiber quality; Nitrogen use efficiency

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棉花(*Gossypium hirsutum* L.)纤维品质是品种遗传特性、资源环境和栽培措施共同作用的结果。Bradow 和 Baure 等<sup>[1-2]</sup>研究表明,棉纤维的品质主要由遗传因素决定,但由环境因素的影响而造成的马克隆值和成熟度变异达 11%~34%,长度和强度变异达 10%~24%。并认为棉纤维价值(品质)的 72%由马克隆值、强度、成熟度和长度决定。

氮素是棉花高产优质的主要限制因素之一,由于棉花的无限开花结铃习性决定了不同开花期棉铃所处的环境条件、生理年龄存在较大差异<sup>[3-4]</sup>,给棉纤维品质的氮素调控带来一定的难度。目前,有关施氮量对棉铃纤维品质生理基础及成熟棉纤维品质指标影响的研究已有较多报道<sup>[5-14]</sup>,但因土壤质地的差异及受化学氮在土壤中流失、转化等因素的影响,不同学者研究的结论也有差异。

我国目前应用于棉田的肥料仍以速溶性复合肥为主,由于棉花的生育期较长,需氮量相对较大,生产上常常倾向于增施氮肥以获得高产,这不但加重了土壤氮淋洗和挥发对环境的污染<sup>[15]</sup>,而且导致因营养体生长过旺而贪青晚熟,前期僵烂花、后期铃及霜后花比重增加,纤维品质大幅度降低<sup>[12,16]</sup>。棉花常规施肥技术以重施基肥合理追肥为基本原则,但多次施肥不但费工,而且提高了植棉成本。为此,本试验设计棉花控释专用肥、控释氮肥及控释氮肥和速效氮肥配施处理,研究其对不同开花期棉铃纤维品质、产量及氮肥利用效率的影响,以期为棉花生产上提高棉花产量、改善棉纤维品质的氮素调控途径提供

理论依据。

## 1 材料与方法

### 1.1 供试材料

棉花品种为鲁棉研 28。速效氮、磷、钾肥分别为尿素(含纯 N 46%)、过磷酸钙(含  $P_2O_5$  14%)、硫酸钾(含  $K_2O$  50%)。控释 4 个月的树脂包膜尿素(含纯 N 42%),控释棉花专用肥(22-10-16)(由包膜肥与普通肥掺混而成,控释 3 个月树脂包膜尿素的氮量约占专用肥总氮量的 29.1%;控释 5 个月树脂包膜尿素的氮量约占专用肥总氮量的 38.9%;控释 5 个月树脂包膜硫酸钾的钾量约占专用肥总钾量的 28.8%)。试验所用肥料均由金正大公司提供。

### 1.2 试验设计

试验在山东农业大学科技示范园大田进行。0~20 cm 土壤含有机质  $15.38\text{ g kg}^{-1}$ 、全氮  $0.84\text{ g kg}^{-1}$ 、碱解氮  $71.01\text{ mg kg}^{-1}$ 、速效磷  $15.91\text{ mg kg}^{-1}$ 、速效钾  $70.21\text{ mg kg}^{-1}$ 。设 2 个对照和 3 个控释肥处理(表 1)。4 月 27 日播种,小区面积  $5.6\text{ m}\times 8\text{ m}$ ,行距 80 cm,株距 33 cm,3 次重复,随机区组排列。7 月 24 日追肥,7 月 25 日打顶,田间管理按常规高产栽培进行。

### 1.3 测定项目与方法

自 7 月 10 日至 8 月 31 日,在每小区内固定 50 株棉花,每日对当天开花的棉株挂牌,标记开花日期。挂牌棉铃吐絮后分单铃摘拾,晒干后按单铃轧取皮棉,然后将每个单铃纤维按开花期混合。将每个混合样品分成 3 份,作为 3 次重复,用 HVI900 纤维测定仪测定纤维品质。

表 1 试验设计  
Table 1 Design of experiment

处理 Treatment	N-P <sub>2</sub> O <sub>5</sub> -K <sub>2</sub> O (kg hm <sup>-2</sup> )	氮肥组成 Nitrogen fertilizer composition	施肥方式 Method of application
CK <sub>1</sub>	0-81.75-130.95	0	—
CK <sub>2</sub>	180-81.75-130.95	100%PU	50%氮肥基施+50%氮肥追施 Half PU as base fertilizer and another half PU as topdressing fertilizer
T <sub>1</sub>	180-81.75-130.95	100%PCU	全部基施 PCU as base fertilizer
T <sub>2</sub>	180-81.75-130.95	50%PU +50%PCU	全部基施 PU and PCU as base fertilizer
T <sub>3</sub>	180-81.75-130.95	CRBBF	全部基施 CRBBF as base fertilizer

PU、PCU、CRBBF 分别表示普通尿素、树脂包膜尿素、控释专用肥。

PU, PCU, and CRBBF denote plain urea, pitch coated urea, and controlled release bulk blending fertilizer, respectively.

参照 Fageria 和 Baligar<sup>[17]</sup>的偏生产力和农学效率的计算方法,偏生产力(partial factor productivity from fertilizer, PFP),是指投入的单位肥料所能生产的作物籽粒产量,即  $PFP=Y/F$ ,式中,Y 为施肥后所获得的作物产量;F 代表肥料的投入量。农学效率(agronomic efficiency of fertilizer, AE),是指单位施肥量所增加的作物产量,即  $AE=(Y-Y_0)/F$ ,式中,Y 为施肥后所获得的作物产量; $Y_0$ 为不施肥条件下作物的产量;F 代表化肥的投入量。

### 1.4 数据统计与分析

采用 Microsoft Excel 2003 和 DPS (Data Processing System)软件分析试验数据。

## 2 结果与分析

### 2.1 不同开花期棉铃纤维品质

2.1.1 纤维长度 由表 2 可以看出,7 月中、下旬和 8 月上旬各处理间虽有差异,但均未达显著水平。8 月中旬, $T_3$  极显著长于  $CK_1$ , $CK_2$  和  $T_1$  显著长于  $CK_1$ ,各施氮处理间差异不显著。8 月下旬, $T_3$  极显著长于  $CK_1$ 、 $CK_2$ 、 $T_1$  和  $T_2$ ,其余处理间差异不显著。

2.1.2 纤维比强度 由表 3 可以看出,7 月中旬和 8 月上旬各处理间虽有差异,但均未达显著水平。7 月下旬, $T_3$  极显著高于  $CK_1$ 、 $CK_2$ , $T_1$  和  $T_2$  均显著高于  $CK_1$ 、 $CK_2$ ,控

释肥处理间差异不显著。8 月中旬, T<sub>1</sub> 和 T<sub>3</sub> 极显著高于 CK<sub>1</sub>, CK<sub>2</sub> 和 T<sub>2</sub> 显著高于 CK<sub>1</sub>, 各施氮处理间差异不显著。8 月下旬, T<sub>1</sub> 和 T<sub>3</sub> 显著高于 CK<sub>1</sub>, 其余各施氮处理与 CK<sub>1</sub> 差异不显著, 等氮条件下, 除 T<sub>3</sub> 显著高于 CK<sub>2</sub> 外, 其他各施氮处理间均无显著差异。

2.1.3 纤维马克隆值 由表 4 可以看出, 7 月中旬各处理间均无显著差异。7 月下旬, CK<sub>2</sub>、T<sub>3</sub> 极显著大于 CK<sub>1</sub>, T<sub>1</sub>

和 T<sub>2</sub> 显著大于 CK<sub>1</sub>, 各施氮处理间差异不显著。8 月上旬, T<sub>3</sub> 极显著大于 CK<sub>1</sub> 和 CK<sub>2</sub>、显著大于 T<sub>1</sub> 和 T<sub>2</sub>, T<sub>1</sub> 和 T<sub>2</sub> 显著大于 CK<sub>1</sub>, CK<sub>2</sub>、T<sub>1</sub> 和 T<sub>2</sub> 间均未达显著差异。8 月中旬, T<sub>3</sub> 极显著大于 CK<sub>1</sub>、CK<sub>2</sub>, T<sub>1</sub> 和 T<sub>2</sub> 显著大于 CK<sub>1</sub>、CK<sub>2</sub>, T<sub>1</sub> 与 T<sub>2</sub> 差异不显著。8 月下旬, T<sub>3</sub> 极显著大于 CK<sub>1</sub>、CK<sub>2</sub> 和 T<sub>2</sub>, T<sub>1</sub> 极显著大于 CK<sub>1</sub>、显著大于 CK<sub>2</sub> 和 T<sub>2</sub>, T<sub>2</sub> 极显著大于 CK<sub>1</sub>, CK<sub>2</sub> 显著大于 CK<sub>1</sub>。

表 2 控释氮肥对不同开花期棉铃纤维长度的影响  
Table 2 Effects of controlled release N fertilizer on fiber length in different blooming stages (mm)

处理 Treatment	开花期 Blooming stage (month/day)				
	7/11–7/20	7/21–7/31	8/1–8/10	8/11–8/20	8/21–8/31
CK <sub>1</sub>	28.00 Aa	29.20 Aa	29.51 Aa	27.95 Bb	27.38 Bb
CK <sub>2</sub>	27.88 Aa	28.72 Aa	29.53 Aa	28.61 ABa	27.45 Bb
T <sub>1</sub>	28.22 Aa	29.37 Aa	29.51 Aa	28.48 ABa	27.31 Bb
T <sub>2</sub>	27.77 Aa	29.11 Aa	29.91 Aa	28.45 ABab	27.00 Bb
T <sub>3</sub>	27.68 Aa	28.80 Aa	29.56 Aa	28.91 Aa	28.71 Aa

表中标以不同小、大写字母的同列数值分别在 0.05 和 0.01 水平上差异显著。  
Values within a column followed by a different small or capital letter are significantly different at the 0.05 and 0.01 probability levels, respectively.

表 3 控释氮肥对不同开花期棉铃纤维比强度的影响  
Table 3 Effects of controlled release N fertilizer on fiber strength in different blooming stages (cN tex<sup>-1</sup>)

处理 Treatment	开花期 Blooming stage (month/day)				
	7/11–7/20	7/21–7/31	8/1–8/10	8/11–8/20	8/21–8/31
CK <sub>1</sub>	27.90 Aa	27.40 Bb	29.60 Aa	25.15 Bb	24.25 Ac
CK <sub>2</sub>	28.40 Aa	27.30 Bb	30.40 Aa	27.40 ABa	24.90 Abc
T <sub>1</sub>	28.65 Aa	28.70 ABa	30.20 Aa	28.90 Aa	25.60 Aab
T <sub>2</sub>	28.15 Aa	28.60 ABa	30.55 Aa	27.50 ABa	25.00 Aabc
T <sub>3</sub>	27.80 Aa	29.55 Aa	30.65 Aa	28.80 Aa	26.25 Aa

表中标以不同小、大写字母的同列数值分别在 0.05 和 0.01 水平上差异显著。  
Values within a column followed by a different small or capital letter are significantly different at the 0.05 and 0.01 probability levels, respectively.

表 4 控释氮肥对不同开花期棉铃纤维马克隆值的影响  
Table 4 Effects of controlled release N fertilizer on fiber micronaire in different blooming stages

处理 Treatment	开花期 Blooming stage (month/day)				
	7/11–7/20	7/21–7/31	8/1–8/10	8/11–8/20	8/21–8/31
CK <sub>1</sub>	4.45 Aa	4.10 Bb	3.05 Bc	2.50 Bc	2.05 Cc
CK <sub>2</sub>	4.30 Aa	4.90 Aa	3.40 Bbc	2.60 Bc	2.65 BCb
T <sub>1</sub>	4.50 Aa	4.80 ABa	3.80 ABb	3.70 ABab	3.15 ABa
T <sub>2</sub>	4.25 Aa	4.70 ABa	3.60 ABb	3.40 ABb	2.75 Bb
T <sub>3</sub>	4.35 Aa	4.90 Aa	4.35 Aa	4.25 Aa	3.50 Aa

表中标以不同小、大写字母的同列数值分别在 0.05 和 0.01 水平上差异显著。  
Values within a column followed by a different small or capital letter are significantly different at the 0.05 and 0.01 probability levels, respectively.

2.1.4 纤维成熟度 由表 5 可以看出, 7 月中旬各处理间虽有差异, 但均未达显著水平。7 月下旬, 除 T<sub>3</sub> 显著高于 CK<sub>1</sub> 外, 其余施氮处理与 CK<sub>1</sub> 均未达显著水平, 各施氮处理间差异不显著。8 月上旬, T<sub>3</sub> 极显著高于 CK<sub>1</sub>、显著高于 CK<sub>2</sub> 和 T<sub>2</sub>, T<sub>1</sub> 显著高于 CK<sub>1</sub>, CK<sub>1</sub>、CK<sub>2</sub> 和 T<sub>2</sub> 间未达显著差异。8 月中旬, T<sub>3</sub> 极显著高于 CK<sub>1</sub>、CK<sub>2</sub> 和 T<sub>2</sub>、显著高于 T<sub>1</sub>, T<sub>1</sub> 极显著高于 CK<sub>1</sub> 和 CK<sub>2</sub>, T<sub>1</sub> 和 T<sub>2</sub> 间未达显著差异。8 月下旬, 控释肥处理 T<sub>1</sub>、T<sub>2</sub> 和 T<sub>3</sub> 显著高于 CK<sub>1</sub>, 施

氮处理间差异不显著。

2.1.5 纤维整齐度 由表 6 可以看出, 除 7 月下旬外, 各处理间虽有差异但均未达显著水平; 7 月下旬, CK<sub>2</sub> 和 T<sub>1</sub> 显著高于 CK<sub>1</sub>, 其余施氮处理与 CK<sub>1</sub> 未达显著差异, 施氮处理间差异不显著。

2.2 棉花产量及氮肥利用率

棉花产量包括籽棉产量和皮棉产量。施氮提高了棉花的籽棉产量和皮棉产量, 各施氮处理与 CK<sub>1</sub> 均达极显

著水平。籽棉产量, T<sub>1</sub>和 T<sub>3</sub>分别比 CK<sub>2</sub>增产 6.2%和 5.0%, 达极显著差异, T<sub>2</sub>与 CK<sub>2</sub>间无显著差异, 但显著低于 T<sub>1</sub>、T<sub>3</sub>。皮棉产量, T<sub>1</sub>比 CK<sub>2</sub>增产 6.4%, 达极显著差异, T<sub>3</sub>比 CK<sub>2</sub>增产 4.31%, 达显著差异, T<sub>2</sub>与 CK<sub>2</sub>间无显著差异。

从表 7 可以看出, 以籽棉产量统计的偏生产力和农学效率, 表现为 T<sub>1</sub> 极显著高于 CK<sub>2</sub>; T<sub>3</sub> 显著高于 CK<sub>2</sub>; T<sub>1</sub> 和 T<sub>3</sub> 显著高于 T<sub>2</sub>; T<sub>2</sub> 与 CK<sub>2</sub> 差异不显著。以皮棉产量统计的偏生产力和农学效率, T<sub>1</sub> 极显著高于 CK<sub>2</sub>、T<sub>2</sub>、T<sub>3</sub>; T<sub>3</sub> 极显著高于 CK<sub>2</sub>、T<sub>2</sub>; T<sub>2</sub> 与 CK<sub>2</sub> 差异不显著。

表 5 控释氮肥对不同开花期棉铃纤维成熟度的影响  
Table 5 Effects of controlled release N fertilizer on fiber maturity in different blooming stages

处理 Treatment	开花期 Blooming stage (month/day)				
	7/11–7/20	7/21–7/31	8/1–8/10	8/11–8/20	8/21–8/31
CK <sub>1</sub>	0.88 Aa	0.89 Ab	0.83 Bc	0.79 Dc	0.77 Ab
CK <sub>2</sub>	0.89 Aa	0.91 Aab	0.84 ABbc	0.80 CDc	0.79 Aab
T <sub>1</sub>	0.89 Aa	0.92 Aab	0.86 ABab	0.85 ABb	0.80 Aa
T <sub>2</sub>	0.88 Aa	0.91 Aab	0.85 ABbc	0.83 BCb	0.80 Aa
T <sub>3</sub>	0.91 Aa	0.94 Aa	0.89 Aa	0.87 Aa	0.80 Aa

表中标以不同小、大写字母的同列数值分别在 0.05 和 0.01 水平上差异显著。  
Values within a column followed by a different small or capital letter are significantly different at the 0.05 and 0.01 probability levels, respectively.

表 6 控释氮肥对不同开花期棉铃纤维整齐度的影响  
Table 6 Effects of controlled release N fertilizer on fiber uniformity in different blooming stages (%)

处理 Treatment	开花期 Blooming stage (month/day)				
	7/11–7/20	7/21–7/31	8/1–8/10	8/11–8/20	8/21–8/31
CK <sub>1</sub>	82.00 Aa	81.50 Ab	81.65 Aa	79.40 Aa	78.35 Aa
CK <sub>2</sub>	82.65 Aa	83.40 Aa	81.80 Aa	79.55 Aa	78.55 Aa
T <sub>1</sub>	82.55 Aa	83.25 Aa	82.45 Aa	80.30 Aa	79.55 Aa
T <sub>2</sub>	81.70 Aa	82.65 Aab	82.15 Aa	80.00 Aa	78.50 Aa
T <sub>3</sub>	82.30 Aa	83.00 Aab	83.35 Aa	81.10 Aa	79.85 Aa

表中标以不同小、大写字母的同列数值分别在 0.05 和 0.01 水平上差异显著。  
Values within a column followed by a different small or capital letter are significantly different at the 0.05 and 0.01 probability levels, respectively.

表 7 氮肥运筹对棉花产量及氮肥利用效率的影响  
Table 7 Effects of nitrogen fertilizer application regimes on yield and nitrogen use efficiency

处理 Treatment	籽棉产量 Seed cotton yield (kg hm <sup>-2</sup> )	偏生产力 PFP (kg kg <sup>-1</sup> )	农学效率 AE (kg kg <sup>-1</sup> )	皮棉产量 Lint cotton yield (kg hm <sup>-2</sup> )	偏生产力 PFP (kg kg <sup>-1</sup> )	农学效率 AE (kg kg <sup>-1</sup> )
CK <sub>1</sub>	3172.11 Cc	—	—	1234.90 Cc	—	—
CK <sub>2</sub>	3400.77 Bb	18.89 Bb	1.28 Bb	1322.22 Bb	7.35 Cc	0.49 Cc
T <sub>1</sub>	3610.80 Aa	20.06 Aa	2.44 Aa	1407.49 Aa	7.82 Aa	0.96 Aa
T <sub>2</sub>	3447.53 ABb	19.16 ABb	1.53 ABb	1321.44 Bb	7.34 Cc	0.48 Cc
T <sub>3</sub>	3571.21 Aa	19.84 ABa	2.22 ABa	1379.21 ABa	7.67 Bb	0.80 Bb

表中标以不同小、大写字母的同列数值分别在 0.05 和 0.01 水平上差异显著。  
Values within a column followed by a different small or capital letter are significantly different at the 0.05 and 0.01 probability levels, respectively.

3 讨论

3.1 控释氮肥对不同开花期棉纤维品质的影响

棉花是对氮素敏感的植物, 氮素代谢状况显著影响纤维品质。大量研究结果表明, 施氮量对棉纤维伸长率、绒长、马克隆值影响比较显著, 对比强度、整齐度影响较小<sup>[5-6]</sup>, 适宜施氮可以改善棉纤维品质<sup>[2,9-11]</sup>, 优化氮肥管理措施能够显著提高纤维长度和比强度, 并确保马克隆值处于最优的品质范围内, 但对伸长率和整齐度无影响<sup>[12]</sup>。

前人的研究多是关于施氮对棉花整个生育期内成熟纤维品质的影响, 关于施氮对某具体时间段内棉铃纤维品质的影响却鲜有报道。本研究表明, 施氮处理增加了 8 月中旬棉铃纤维长度和 8 月份棉铃纤维成熟度, 增大了 7 月中旬以后的棉铃纤维马克隆值, 增强了 7 月下旬和 8 月中旬棉铃纤维比强度, 但对纤维整齐度无显著影响。控释氮肥改变了普通氮肥速效、短效的特点, 持续稳定地释放出养分<sup>[18]</sup>, 显著提高植物叶片叶绿素含量, 改善叶肉细胞的光合能力, 提高叶片光合效率<sup>[19-20]</sup>, 为棉花生育中后期

棉铃发育提供了较理想的环境。本研究发现,与普通氮肥处理相比,3个控释氮肥处理均显著增大了普通氮肥追肥前(7月下旬)棉铃的纤维比强度和8月中旬棉铃的纤维马克隆值,增加了8月中旬棉铃的纤维成熟度。此外,100%树脂包膜尿素处理还显著增大了8月下旬棉铃的纤维马克隆值;棉花专用肥处理显著增大了8月上旬棉铃的纤维马克隆值和8月下旬棉铃纤维长度、纤维比强度、纤维马克隆值,增加了8月上旬棉铃的纤维成熟度。其余开花期各施氮处理间差异不显著,这可能是由于某些开花期棉株尚处于轻度缺氮情况,有限的光合物质优先分配到生殖器官<sup>[17]</sup>,有利于纤维品质形成。

### 3.2 控释氮肥对棉花产量及氮肥利用效率的影响

关于控释氮肥对作物产量影响的研究已有较多报道,但在棉花上的应用研究报道较少<sup>[19,21]</sup>。孙强生等<sup>[21]</sup>报道,每千克土施用0.2 g和0.4 g纯氮时,包膜控释肥比普通复合肥具有显著的增产作用。李伶俐等<sup>[19]</sup>研究表明,等氮条件下,控释肥提高了单株结铃数和单铃重,籽棉显著增产10.3%。本试验也表明,施氮极显著增加了籽棉产量和皮棉产量。等氮条件下,棉花专用肥处理籽棉产量和皮棉产量分别比普通氮肥处理增加5.0%和4.31%,达显著差异水平;100%树脂包膜尿素基施处理籽棉产量和皮棉产量分别比普通氮肥处理增加6.2%和6.4%,达极显著水平;从而显著或极显著地提高了以籽棉和皮棉产量统计的偏生产力和农学效率。这是由于100%树脂包膜尿素基施处理和棉花专用肥处理延缓了45 d和60 d叶片中叶绿素的分解,增加了叶绿素含量,改善了棉花叶片的光合特性,单株结铃数显著或极显著的增加了0.77个和0.84个<sup>[20]</sup>,50%普通尿素+50%树脂包膜尿素基施处理与普通氮肥处理比较,籽棉产量、皮棉产量和氮肥利用效率差异均不显著,且显著或极显著低于100%树脂包膜尿素基施处理和棉花专用肥处理,其原因有待进一步探讨。

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