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Effect of potassium foliar fertilizer application on cotton yield, yield components and fiber quality, and nutrient use efficiency of three cotton varieties

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ABSTRACT

An effective management strategy for potassium (K) foliar fertilizer was important to optimum cotton yield and fiber quality. The study was conducted in split-plot design with three replicates, and the basal potassium fertilizer application (90 kg K ha⁻¹) plus five different K foliar rates (0 %, 0.5 %, 1 %, 1.5 %, and 2 %) and three varieties (Ngwechi-6, LGNC-4, and Shwe Daung-8). The K₄ (1.5 % K foliar) gave significantly increased seed cotton yield per plant (105.63 g), the highest seed cotton yield (1809.7 kg ha⁻¹), the highest lint yield (607.4 kg ha⁻¹), and cottonseed yield (1202.3 kg ha⁻¹) in this experiment. The K₄ treatments gave the highest potassium uptake 1.87 and the highest dry matter content (164.39 g plant⁻¹). The K₁ (control) formed the lowest potassium uptake 1.22 and the lowest dry matter amount (116.78 g plant⁻¹). The high K-uptake was consistent with high seed cotton yield in K-foliar application (K₄). Shwe Daung-8 variety was responded on K-foliar application which produced on the plant the maximum number of fruit setting (70.14), the maximum number of total bolls (26.63), the maximum number of picking bolls (23.46), the percentage of opened bolls (87.58 %), and the lowest fruit shedding percentage (12.59 %). Therefore, experimental result showed that potassium fertilizer application is more important by cotton cultivars with K-rate and added % of K-foliar application in the efficient utilization for increased cotton production.

Keywords - Potassium foliar fertilizer, Cotton yield, Fiber quality, and Dry matter

INTRODUCTION

Myanmar cotton production in 2018

- ❖ Production was 700 thousand (Unit of 1000, 480 lb. bales⁻¹)
- ❖ Harvested area was 240 thousand hectare
- ❖ Domestic consumption was 775 thousand bales
- ❖ Rate of seed cotton yield as 635 kg ha⁻¹
- ❖ Myanmar cotton production playing at the extensive route road (Ref.1)
- ❖ Both cotton yield and fiber quality –the availability of adequate and balanced plant nutrients



K requirement for cotton production

- ❖ Potassium - a vital nutrient in cotton production. (Ref.2)
- ❖ Potassium foliar applications offer mid-season deficiencies quickly and efficiently, especially in the late season when soil application of K may not be sufficient. (Ref.3)
- ❖ Split utilization of potassium can help to reduce the effect of loss by leaching from sandy soil, low cation exchange capacity soils in high rainfall region. (Ref.4)

Effects of K on Cotton Yield Components

In preliminary research results - K fertilizer rates

90 kg K ha⁻¹ application significantly positives effects increased

- Total fruit setting 16 %
- Percent of opening bolls 18 %
- Boll weight 10 %
- Seed weight 5 %
- Seed cotton yield 41 %
- Lint yield 40 %
- more than control treatment in the experiment of post-monsoon season, 2017



OBJECTIVES: To evaluate the effects of K fertilizer and addition of K-foliar spraying on plant growth, yield, yield components, and fiber quality of cotton

MATERIAL AND METHOD

Experimental Site - Aunglan Technological Farm



Experimental Design - Split-Plot

Experimental Area - 0.15 ha

Plot size - 4.5 m × 7.5 m

Spacing - 0.75 m × 0.75 m – 2 plants / hole

Period; - 2018- monsoon (June -October)

Main plot –three varieties

1. Ngwechi - 6 (140-150 days)

2. LGNC - 4 (155-165 days)

3. Shwe Daung - 8 (160-170 days)

Sub plot – Five K foliar fertilizer treatments

Treatments	Application Time		
	Bud formation (60 DAE)	Flowering (75 DAE)	Boll formation (90 DAE)
K 1 (0 %)	-	-	-
K 2 (0.5 %)	✓	✓	✓
K 3 (1.0 %)	✓	✓	✓
K 4 (1.5 %)	✓	✓	✓
K 5 (2.0 %)	✓	✓	✓

Time of Fertilizer application ❖ Urea 180 kg (84 kg N ha⁻¹) and Potash 110 kg (90 kg K ha⁻¹)

- ❖ 25 % as basal, 50 % as beginning of square formation, 25 % as beginning of flowering
- ❖ T-super 124 kg (24 kg P ha⁻¹) – 100 % of T-super as sowing time. This amount was used in all treatments
- ❖ F.Y.M 6 ton ha⁻¹ - F.Y.M was used application in all treatments

Data Analysis : Analysis of variance was performed by STATISTIX 8. treatments means compared with Least Significant Difference (LSD) at 5% level .

Data calculation

K uptake = K concentration × dry matter weight

K use efficiency (KUE) = $\frac{\text{Seed cotton yield}}{\text{Total K uptake}}$

Partial Factor Productivity of Potassium (PFP-K) = $\frac{\text{Yield (kg ha}^{-1})}{\text{Applied K (kg ha}^{-1})}$

Harvest Index (HI) = $\frac{\text{Economic Yield}}{\text{Biological Yield}}$ or $\frac{\text{Seed Yield (kg ha}^{-1})}{\text{Total Dry Matter (kg ha}^{-1})}$



RESULTS AND DISCUSSION

Table (1) Mean effects of varieties and potassium foliar fertilizer rates on yield component parameters, in monsoon season, 2018

Treatments	Fruit setting	Total bolls	picked bolls	Fruit shedding (%)	Opened bolls (%)	Boll weight (g)
Varieties						
Ngwechi-6	62.5	20.9 b	17.9 b	12.8 b	85.0 a	4.98
LGNC- 4	62.4	21.5 b	16.5 b	15.7 a	76.3 b	4.86
Shwe Daung-8	70.1	26.6 a	23.5a	12.6 b	87.6 a	4.74
LSD _{0.05}	4.09	1.14	0.92	0.68	1.01	0.11
K-foliar						
K ₁ (0 %)	66.2	22.1	18.6 b	16.8a	83.8 abc	4.88
K ₂ (0.5 %)	64.9	23.6	18.6 ab	13.1bc	78.5bc	4.75
K ₃ (1%)	63.9	22.1	17.3b	14.0b	74.81c	4.97
K ₄ (1.5%)	64.6	22.4	20.6ab	13.0bc	91.9 a	4.75
K ₅ (2%)	65.6	24.8	21.3 a	11.7 c	85.8ab	4.96
LSD _{0.05}	3.91	1.02	1.24	0.77	3.34	0.11
P\geqF						
Varieties	ns	**	**	**	**	ns
K-foliar	ns	ns	ns	**	**	ns
V & K	ns	**	**	**	**	ns
CV % (a)	24.39	19.16	18.57	19.31	4.71	9.06
CV % (b)	18.06	13.41	19.37	16.93	12.07	6.85

In each column, means having the same letter are not significantly different at 5 % significant level



Table (2) Effects of varieties and potassium foliar fertilizer rates on yield and seed quality parameters, in the monsoon season, 2018

Treatments	cotton yield (kg ha ⁻¹)	Lint yield (kg ha ⁻¹)	seed yield (kg ha ⁻¹)	1000 seed weight (g)	% of Seed germination
Varieties					
Ngwechi-6	1734.9	567.8	1167.1	105.7 ab	86.20
LGNC- 4	1657.3	556.7	1100.6	101.9 b	88.20
Shwe Daung-8	1779.5	623.7	1155.7	107.2 a	87.67
LSD _{0.05}	85.22	36.58	48.95	0.99	1.38
K-foliar					
K ₁ (0%)	1586.2	536.2	1050.1	108.2	88.56 ab
K ₂ (0.5%)	1755.7	597.9	1157.8	103.5	86.22 ab
K ₃ (1%)	1694.3	578.6	1115.6	105.1	90.22a
K ₄ (1.5%)	1809.7	607.4	1202.3	103.1	86.33 ab
K ₅ (2%)	1773.5	593.6	1180.0	104.7	85.44b
LSD _{0.05}	111.59	37.75	74.66	2.34	1.63
P\geqF					
Varieties	ns	ns	ns	**	ns
K-foliar	ns	ns	ns	ns	ns
V & K	ns	ns	ns	ns	ns
CV % (a)	19.15	24.31	16.61	3.65	6.12
CV % (b)	19.42	19.43	19.63	6.69	5.60

In each column, means having the same letter are not significantly different at 5 % significant level

Table (3) Mean effects of cotton varieties and different potassium foliar fertilizer rates on fiber quality parameters in the monsoon season, 2018

Treatments	Ginning (%)	length (mm)	strength (lb./mg)	fineness (micronaire)	maturity ratio	Uniformity ratio
Varieties						
Ngwechi-6	32.65	28.78	8.03	4.26	0.95	91.31 b
LGNC-4	33.56	29.32				