

Relationship Between NK Nutrition and Leaf Diseases of Cotton Crop Cultivated in Brazilian Cerrado Region

Maria da Conceição S. Carvalho¹, Nelson D. Suassuna¹

¹Brazilian Agricultural Research Corporation – Embrapa, P.O. Box 179, Zip code: 75375-000, Santo Antônio de Goiás, GO, Brazil (maria.carvalho@embrapa.br; nelson.suassuna@embrapa.br)

INTRODUCTION

Nowadays, more than 90% of Brazilian cotton production comes from the Cerrado region. Fertilization with nitrogen (N) and potassium (K) is essential to maintain high cotton yield and lint quality in that region, since the most part of its soils are acidic and poor in nutrients.

Although disease resistance is genetically controlled, is well known that a balanced nutrient supply is a very important environmental factor in plant diseases prevention. On the other hand, nutrient imbalances caused by excessive use of fertilizers, especially nitrogen, may promote favorable conditions to increase incidence of plant diseases, especially leaf spots caused by fungi (Veresoglou et al. 2012). In Brazilian Cerrado region, the losses in cotton yield caused by *Ramularia* and *Alternaria* leaf spots are estimated to be around 30%.

This study aimed at evaluating the influence of N and K fertilization of cotton (*Gossypium hirsutum*) on leaf nutrient contents, yield, and severity of leaf spots caused by *Ramularia areola* and *Alternaria macrospora*.

METHODS

The experiment was carried out under field conditions on a clayey Typic Haplustox in Santa Helena de Goiás, Goiás, Brazil. Some soil test results in the 0-20 cm layer were: organic matter=35 g dm⁻³; P= 3.0 mg dm⁻³; K, Ca, and Mg equal to 0.06, 1.6, and 0.3 cmol_c dm⁻³, respectively.

We used a complete randomized block design with four replications and 25 treatments arranged in a 4x6+1 factorial scheme: four N rates (60, 120, 180, and 240 kg ha⁻¹), six K rates (60, 100, 140, 180, 220, and 260 kg ha⁻¹ of K₂O), and one additional treatment with 16 kg N and 60 kg K₂O per hectare. Fertilization at seeding was performed using 400 kg ha⁻¹ of 4-30-15+Zn+B fertilizer formulation. Nitrogen and K fertilization, according to the treatments, were splitted at two applications at 25 and 45 days after emergence of plants using urea and potassium chloride.

We evaluated leaf macronutrient content and cotton yield. The severity of *R. areola* and *A. macrospora* leaf spots was evaluated at flowering, using the following rating scale: 1 = 0%, 2 = up to 5%, 3 = 5.1 to 25%, 4 = 25.1 to 50%, and 5 = over of 50% of leaf area with symptoms. Data were analyzed statistically with analysis of variance (Pr<0,05) and regression analysis for N and K rates.

RESULTS AND DISCUSSION

Fertilization with N and K increased cotton yield as well as the content of these nutrients in the leaves (Table 1). The maximum yield (4,200 kg ha⁻¹) was achieved when we applied 170 and 190 kg ha⁻¹ of N and K₂O, respectively. Doses above these values caused a decrease in productivity, probably due to nutritional imbalance. High rates of K induced the reduction of Ca and Mg in cotton leaf, increasing K:Mg ratio and decreasing N:K and Ca:K ratios (Table 1). Higher yields were associated with foliar levels of 40 to 44 g kg⁻¹ N and 17 to 22 g kg⁻¹ K in dry matter.

The severity of both *Alternaria* and *Ramularia* leaf spots was highest at the lowest applied rate of N and K, indicating that the deficiency of these nutrients in cotton plants makes them more susceptible to these diseases. Potassium supply reduced the severity of these diseases, which was related to the increase of K content in the leaves; however, the increase in N:K ratio was positively correlated with increasing severity of such diseases (Fig. 1).

Table 1. Cotton yield, nutrients content, and nutrients ratio in the cotton leaf, according to the application of N and K rates in a low fertility soil in Brazilian Cerrado region.

N or K ₂ O rates (kg ha ⁻¹)	Yield (kg ha ⁻¹)	N	K	Ca	Mg	N:K ratio	K:Mg ratio	Ca:K ratio
		(g kg ⁻¹)						
N rates								
16	3363	34.7	6.3	43.3	4.3	5.5	1.5	6.9
60	3880	39.7	16.8	35.8	4.1	2.4	4.1	2.1
120	3978	41.2	17.6	36.2	4.4	2.3	4.0	2.1
180	4027	42.4	18.2	34.6	4.2	2.3	4.3	1.9
240	4001	43.7	16.1	38.8	4.4	2.7	3.7	2.4
Regression analyses	Q*	L***	Q*	Q*	ns	Q**	Q*	Q*
K₂O rates								
64	3651	39.6	8.2	41.4	4.1	4.8	2.0	5.1
100	3652	41.2	12.2	39.5	4.8	3.4	2.5	3.3
140	4128	42.3	16.6	36.1	4.5	2.5	3.7	2.2
180	4222	41.6	19.6	35.4	4.5	2.1	4.3	1.8
220	4110	42.1	21.8	33.7	4.1	1.9	5.3	1.5
260	3994	42.6	24.3	32.4	3.6	1.8	6.7	1.3
Regression analyses	Q***	ns	L***	L***	Q*	L***	Q***	L***

ns= not significant; L= linear model; Q= quadratic model; *, **, and *** = significant at 5%, 1%, and 0.1%, respectively.

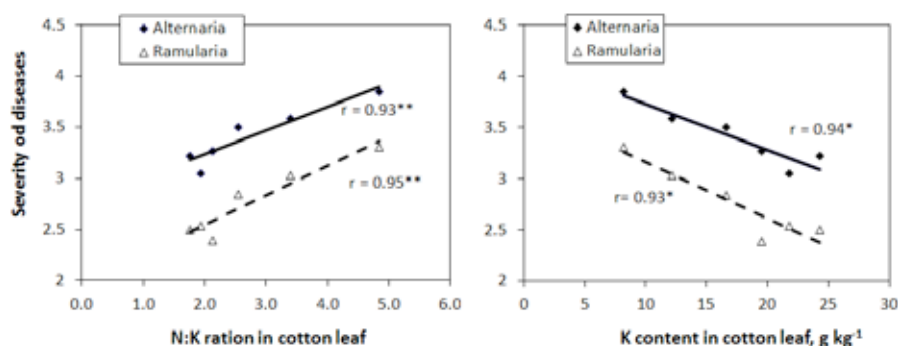


Fig. 1. Correlation between N:K ratio or K content in cotton leaf and severity of *Ramularia* and *Alternaria* leaf spots.

CONCLUSION

The fertilization of cotton with balanced rates of nitrogen and potassium in a low fertility soil from the Brazilian Cerrado region improved the nutritional status of plants, reduced the severity of leaf spots caused by *Ramularia areola* and *Alternaria macrospora*, and increased cotton yield.

ACKNOWLEDGEMENTS

The authors would like to thank International Potash Institute – IPI, Brazilian Agricultural Research Corporation (Embrapa), FIALGO, and Goiás Foundation that have supported this research.

REFERENCES

Veresoglou, S. D., Barto, E. K., Menexes, G. and Rillig, M. C. (2012), Fertilization affects severity of disease caused by fungal plant pathogens. *Plant Pathology*. doi: 10.1111/ppa.1201