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THE EFFECT OF POTASSIUM NITRATE ON FLUE-CURED TOBACCO

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ABSTRACT

A field experiment was conducted in the course of 1994-1996 at the experimental field of Tobacco Institute Cerrik (in Albania) to determine the response of flue-cured tobacco to different rates and date of potassium nitrate application.

Potassium nitrate was applied at rates of 2, 3, and 4q/ha or 26:77; 39:115 and 52:154 kg/ha N and K_2O respectively. These rates were combined with two dates of its application (1-pretransplanting and 2-during growing). Another treatment was used also with the last of potassium nitrate rate (4q/ha), which was divided in two times of application (1/2 before transplanting and1/2 during growing). All these KNO3 treatments were compared to conventional nitrogen and potassium fertilization for flue cured tobacco (50kg/haN as NH_4NO_3 and 150kg/ha K_2O as K_2SO_4) and control (check un-fertilized). Phosphorus (P_2O_5) was applied at a uniform rate of 75 kg/ha (5q/ha superphosphate), as background for fertilized treatments and as special plot too.

Our data showed that:

Application of KNO_3 in flue-cured tobacco improved its quality compared to this of the same N and K rate applied as NH_4NO_3 and K_2SO_4, respectively.

Yields and quality characteristics were more favorable when N and K_2O (as KNO_3) applied pre-transplanting, compared to these of the same rates applied during growing.

For the climatic and territorial conditions of Cerrik region (in Albania) the high yields and quality were obtained from the application of 3q/ha KNO_3 pre-transplanting in the background of 5 quintal/ha superphosphate.

INTRODUCTION

Growth and development, yield and quality of tobacco plant is influenced by many factors, including nitrogen and potassium fertilization (1.8).

Several investigators reported that tobacco yield increased when the applied nitrogen increased up to a limit, further increase above it did not effect the yield, whereas the quality was lowered (8,9,3).

In the relation to the effect of potassium on the tobacco plant there are a lot of studies, too. Some of them showed that the rate of potassium used had no significant effects on yield, but considerably improved its quality, although there was a trend to increase the yield (8,9). Other studies found that use of potassium up to a determined rate increased significantly the tobacco yield and somewhat of its quality. So, for flue-cured tobacco, Hawks et al. (7) found no significant differences in yield when the potassium fertilization rates increased above 113 kg per hectare, or Sierra (11) reported that no yield increase was obtained when more than 137 kg K/ha were used, whereas Mylonas et al. (10) for Samsun tobacco told that the beneficial K rate is up to 60 kg/ha. No additional yield or quality response to potassium occurred above those rates. Others pointed that phosphorus and potassium levels had no real effects on yield and price index of Flue-cured tobacco (4, 5).

The objectives of this study were to evaluate the effects of nitrogen (N) and potassium (K) through application of potassium nitrate, as well as the time of its use on flue-cured tobacco growing in the climatic-territorial condition of Cerrik region.

MATERIAL AND METHOD

The study was conducted from 1994 to 1996 on a sandy-silt soil in the experimental field of Tobacco Institute of Cerrik. Some physical and chemical characteristics of the soil are given in Table 1 and 2.

Table 1 Texture of soil.

Years	(Soil separates in %)		
	Sand	Silt	Clay
1994	44.6	23.3	32.1
1995	48.5	28.4	23.1
1996	50.3	24.5	25.2

Table 2 - Agrochemical analyses of soil

Years	pH.in H_2O	Humus	Total Nitrogen	Available nutrients in mg/100gr soil	
				P_2O_5	K_2O
1994	6.93	1.3	0.098	1.49	10.0
1995	6.6	1.86	0.155	2.48	14.8
1996	6.51	1.27	0.097	2.03	9.2

The treatments used in the experiment were as follows:
1-Control (unfertilized) (Check).
2-75kg P/ha (Pre-transplanting) (Background).
3-Backgr.+50kg N/ha (asNH_4NO_3) (Post-transplanting) +150kg K/ha (as K_2SO_4) (Pre-transplanting) (Standart).
4-Backgr.+26kg/haN:77kg/haK (or 2 q/ha KNO_3) (Pre-transplanting).
5-Backgr.+39kg/haN:115.5kg/ha K (or 3 q/ha KNO_3) (Pre-transplanting).
6-Backgr.+52kg/haN:154kg/ha K (or 4 q/ha KNO_3) (Pre-transplanting).
7-Backgr.+26kg/haN:77kg/haK (or 2 q/ha KNO_3) (Post-transplanting).
8-Backgr.+39kg/haN:115.5kg/ha K (or 3 q/ha KNO_3) (Post-transplanting).
9-Backgr.+52kg/haN:154kg/ha K (or 4 q/ha KNO_3) (Post-transplanting).
10-Backgr.+52kg/haN:154kg/ha K (or 4 q/ha KNO_3) (1/2 Pre-transplanting and 1/2 Post-transplanting).

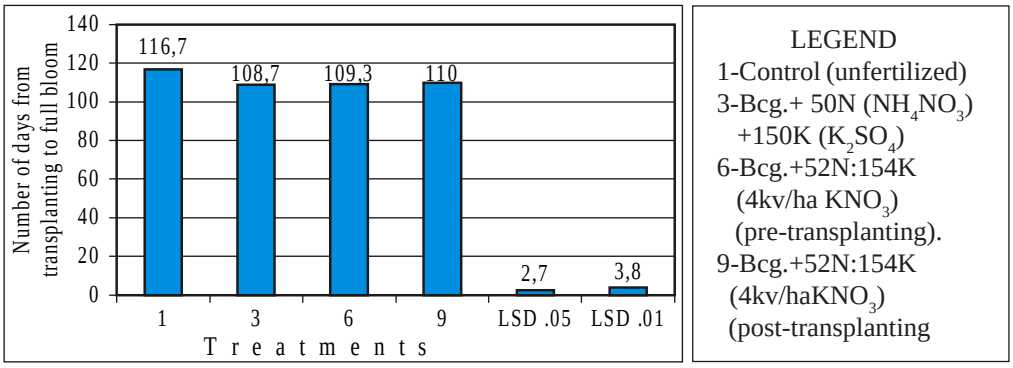
To sum up the treatments used we can say: potassium nitrate was applied at rates of 2, 3, and 4q/ha. These rates were combined with two times of its application, pre-transplanting and post-transplanting. Another treatment was used with last rate of potassium nitrate (4q/ha) which was divided equally in two times of application. The resulting 7 KNO_3 treatments were compared to the conventional N and K fertilization for flue-cured tobacco (third plot), and control. Phosphorus was applied at a uniform rate of 75kg/ha as background for all treatments, except control, and as a special plot too. All the nitrogen and potassium applied after transplanting were used a half before first cultivation and the other half before the second one.

Cultural practices for plant bed preparation, planting date, cultivation, irrigation, harvesting and curing, and insect and disease control were the same as for flue-cured tobacco.

After curing, leaves for each plot were sorted, weighed and graded. The analysis of variance of collected data were combined over the three investigated years.

RESULTS AND DISCUSSION

Application of the fertilizers in general and those of nitrogen and potassium ones, especially, had shortened the vegetation of flue-cured tobacco. Full bloom (one half of plant had at least one open flower) in the fertilized treatments took place 5-10 days earlier than the control (unfertilized). It is significant per 1% level of probability. There were no significant differences in growing duration among the treatments fertilized with KNO_3 apart from rates and times of its application (Table 3 and Graph 1).



Graph 1 - Length of growing period in flue-cured tobacco

The plant height increased significantly (5-12%) in treatments fertilized over the plot unfertilized (Table 3).

Fertilizer application on flue-cured tobacco decreased the number of harvestable leaves per plant. However, there was no significant reduction in number of leaves for plants fertilized with the lowest rate of nitrogen (26 kg/ha) as KNO_3 in both times of its application. The greatest significant reduction occurred in treatments fertilized with high nitrogen rates (39 and 52 kg/ha) as KNO_3 and 50kg/ha as NH_4NO_3), always in comparison to plots; unfertilized or in the presence of P fertilization (Table 3).

Table 3 - Some bio-morphological properties of flue-cured tobacco

No	Treatment		Length of growing period (days).	Height of plant-cm	No. of harvestable leaves/plant
1	Control (unfertilized)		116.67 a	163.8 d	42.09 a
2	75kg P/ha (background)		113.00 b	171.8 c	43.17 a
3	Backg.+50kgN/ha (asNH_4NO_3) +150kg K/ha (as K_2SO_4)		108.67 c	179.8 a	37.38 d
4	Backg.+26kg N/ha : 77kg K/ha (as KNO_3)	pre-transplanting	112.00 b	171.5 c	42.10 a
5	Backg.+39kgN/ha:115.5kg K/ha (as KNO_3)		110.67 bc	178.8 ab	40.48 b
6	Backg.+52kg N/ha : 154kg K/ha (as KNO_3)		109.33 bc	178.1 ab	38.96 c
7	Backg.+26kg N/ha : 77kg K/ha (as KNO_3)	post transplanting	111.33 b	173.1 bc	41.94 ab
8	Backg.+39kgN/ha:115.5kg K/ha (as KNO_3)		110.33 bc	173.9 bc	38.85 cd
9	Backg.+52kg N/ha : 154kg K/ha (as KNO_3)		110.00 bc	174.3 bc	37.65 cd
10	Backg.+52kg N/ha : 154kg K/ha (as KNO_3) (1/2 pretransplanting-1/2 post-transplanting		107.00 c	183.2 a	38.87 cd

• Any two means, in a column, not followed by the same letter or letters are significantly different (P=.05).

The data of Table 4 showed that application of fertilizer on flue-cured tobacco increased also the size of leaves. So the length and width of middle leaf were, respectively, 3.6-12.8 and 4.2-16.7% greater in fertilized treatments than in unfertilized ones. This increase was significant for at least 5% level of probability. The greatest sizes of middle leaves were obtained in the plots fertilized with the highest rates of N, either as NH_4NO_3 or KNO_3.

Tabe 4 - Main leaves properties

No.	Treatment		Specific leaf weight-gr/m^2		Percent of principal leaf vein	Size of middle leaf.	
			middle leaf	top leaf		Length-cm	Width-cm
1	Control (unfertilized)		57.33 ab	68.93 a	35.13 ab	47.57 c	20.93 d
2	75kg P/ha (background)		59.21 a	70.30 a	34.73 b	49.83 b	21.80 c
3	Backg.+50kgN/ha (asNH_4NO_3) +150kg K/ha (as K_2SO_4)		48.23 c	63.91 a	36.27 ab	53.67 a	24.63 a
4	Backg.+26kg N/ha : 77kg K/ha (as KNO_3)	pre-trans-plant-ing	56.55 ab	69.75 a	35.30 ab	49.30 b	22.50 bc
5	Backg.+39kgN/ha:115.5 kg K/ha (as KNO_3)		53.58 abc	67.86 a	35.63 ab	51.83 ab	23.33 ab
6	Backg.+52kg N/ha : 154kg K/ha (as KNO_3)		51.73 bc	65.14 a	36.30 ab	51.43 ab	23.00 bc
7	Backg.+26kg N/ha : 77kg K/ha (as KNO_3)	post-trans-plant-ing	56.55 ab	69.27 a	35.50 ab	50.40 b	22.83 bc
8	Backg.+39kgN/ha:115.5 kg K/ha (as KNO_3)		50.30 bc	66.25 a	36.00 ab	51.73 ab	23.60 ab
9	Backg.+52kg N/ha : 154kg K/ha (as KNO_3)		48.99 bc	63.95 a	36.60 a	51.67ab	23.33 ab
10	Backg.+52kg N/ha : 154kg K/ha (as KNO_3) (1/2 pretransplanting-1/2 post-transplanting		49.57 bc	66.65 a	36.27 ab	53.53 a	24.43 a

• Any two means, in a column, not followed by the same letter or letters are significantly different (P=.05).

Varying the time of KNO_3 application did not significantly affect the size of middle leaf for treatments fertilized with the same rate .

The percent of principal leaf vein, did not differ significantly , although a trend existed to be greater (0.5-4.2 %) in treatments receiving N and K (Table 4).

While the above leaf properties increased either significantly or not, the specific leaf weight reduced slightly. The greater reducing was noted in the leaves of middle belt, although should be stressed that the significant differences were only for plots fertilized with NH_4NO_3 + K_2SO_4 and high KNO_3 rates (especially when KNO_3 were used during growing period) .

Table 5 - Yield and quality of flue-cured tobacco

No	Treatments		Yield-kv/ha	% of I+II class.
1	Control (unfertilized)		29.09 e	68.75 c
2	75kg P/ha (background)		31.12 d	67.68 c
3	Backg.+50kgN/ha (asNH_4NO_3) +150kg K/ha (as K_2SO_4)		35.95 a	70.27 bc
4	Backg.+26kg N/ha : 77kg K/ha (as KNO_3)	pre-trans-planting	33.47 c	76.77 ab
5	Backg.+39kgN/ha:115.5kg K/ha (as KNO_3)		34.77 b	79.50 a
6	Backg.+52kg N/ha : 154kg K/ha (as KNO_3)		35.29 ab	75.27 ab
7	Backg.+26kg N/ha : 77kg K/ha (as KNO_3)	post-trans-planting	32.90 c	76.67 ab
8	Backg.+39kgN/ha:115.5kg K/ha (as KNO_3)		33.63 c	73.10 ab
9	Backg.+52kg N/ha : 154kg K/ha (as KNO_3)		33.80 c	71.17 bc
10	Backg.+52kg N/ha : 154kg K/ha (as KNO_3) (1/2 pretransplanting-1/2 post-transplanting		35.51 ab	78.10 a

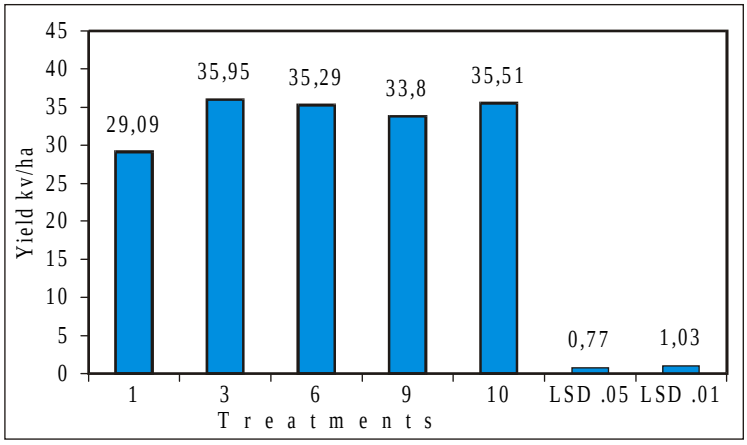
• Any two means, in a column, not followed by the same letter or letters are significantly different (P=.05).

Dry matter of leaves of the top belt was not affected significantly by fertilization, although a trend existed for N fertilizer in generally, and especially NH_4NO_3, to decrease it essentially.

The yield of N and K fertilized treatments were 20-25% higher than that of unfertilized treatment (Table 5 and Graph 3). There were not significant differences among treatments with the same N and K fertilizer rate, either when they

are used as NH_4NO_3 + K_2SO_4 or as KNO_3 pre-transplanting. Increases in the yield were significantly greater when KNO_3 was applied pre-transplanting than post-transplanting.

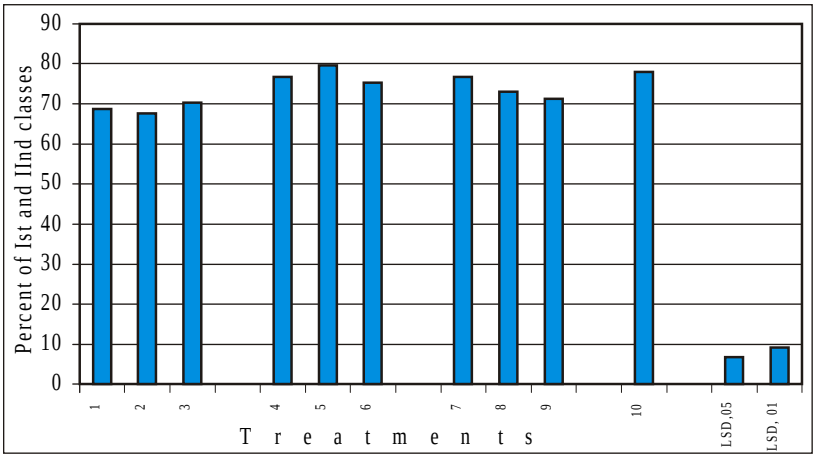
Graph 2 - Yield of flue-cured tobacco



LEGEND
1-Control (unfertilized)
3-Bcg.+ 50N(NH_4NO_3) +150K (K_2SO_4)
6-Bcg.+52N:154K (4q/ha KNO_3) (pre-transplanting)
9-Bcg.+52N:154K (4q/haKNO_3) (post-transplanting)
10-Bcg.+52N:154K (4q/haKNO_3) (1/2 pre-transplanting and 1/2 post-transplanting)

The greatest effect of fertilizer in general, and rates and times of KNO_3 application especially, was reflected on the quality of flue-cured tobacco (Table 5 and Graph 3). Applying of N and K fertilizer on the flue-cured tobacco improved its quality for 2.2-16%. It was more significant in KNO_3 plots than in those receiving the other N and K fertilizer.

Between the two times of KNO_3 application the best quality results (for the same rate) were obtained when it was broadcast pre-transplanting than after transplanting.



LEGEND
1-Control (unfertilized)
2-5q/ha Superphosphate (Background)
3-Bcg.+ 1.5q/ha($NH4NO_3$) +3q/haK (K_2SO_4)
4-Bcg.+26N:77K (2q/ha KNO_3) (pre-transplanting).
5-Bcg+39N:115.5K (3q/ha KNO_3) (pre-transplanting).
6-Bcg.+52N:154K (4q/ha KNO_3) (pre-transplanting).
7-Bcg.+26N:77K (2q/ha KNO_3) (post-transplanting).
8-Bcg+39N:115.5K (3q/ha KNO_3) (post-transplanting).
9-Bcg.+52N:154K (4q/ha KNO_3) (post-transplanting)
10-Bcg.+52N:154K (4q/ha KNO_3 (1/2pretransplanting and 1/2 post-transplanting

Graph 3 - Percent of high classes of flue-cured tobacco

CONCLUSIONS

1 - Fertilization of flue-cured tobacco with KNO_3 was more favorable than use of any other N and K fertilizer.

2 - For obtaining the highest possible yield and quality of flue-cured tobacco in Cerrik and other areas with similar growing season it is important to make pre-transplanting application of 39 kg N/ha and 115.5kg K/ha as KNO_3 in the presence of 75kg P/ha.

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ВЛИЈАНИЕ НА КАЛИУМ НИТРАТОТ ВРЗ ТУТУНОТ СУШЕН НА ОГАН

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РЕЗИМЕ

Изведуван е полски опит на експерименталното поле од Институтот за тутун - Черик, Албанија, за да се определи реакцијата на flue-cured тутунот во зависност од дозата и датумот на примена на калиум нитрат.

Калиум нитратот е применет во дози од 2, 3 и 4 kv/ha или 26:77, 39:115 и 52:154 kg/ha N и K_2O, соодветно. Овие дози се аплицирани на два датума (првата-пред расадување и втората-во текот на вегетациониот период). Друго третирање е исто така извршено со последната доза на калиум нитрат (4 kv/ha), која е поделена на две апликации (1/2 пред расадување и 1/2 во текот на вегетациониот период). Сите овие третирања со KNO_3 се споредени со конвенционалното ѓубрење со азот и калиум на flue-cured тутунот (50 kg/haN како NH_4NO_3 и 150 kg/ha K2O како K_2SO_4), плус контролата (нетретирана). Фосфорот (P_2O_5) е применет во единствена доза од 75 kg/ha (5kv/ha суперфосфат).

Нашите податоци го покажаа сл:

Со примена на KNO_3 кај flue-cured тутунот се подобрува неговиот квалитет повеќе отколку со истата доза на N и K_20 применети како NH_4NO_3 и K_2SO_4, соодветно.

Карактеристиките на приносот и квалитетот се подобри кога N и K_20 (како KNO_3) се применуваат пред расадување, отколку истите дози применети во текот на вегетацијата.

Во климатските и почвените услови на реонот на Черик, Албанија, добиен е висок принос и квалитет со примена на 3 kv/ha KNO_3 пред расадување.

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