

Effect of Different Nitrogen Fertilizer Levels on Development of Nicotine in Flue Cured Tobacco (*Nicotiana tabacum*)

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Introduction

The tobacco plant is one of the very few crops entering world trade entirely on a leaf basis. It is the most widely grown commercial non food plant in the world (Akehurst, 1981). The botanical genus *Nicotiana* contains over sixty four species. *Nicotiana tabacum* is the source of commercial tobacco, which is a member of the family *Solanaceae* and it is grown as an annual crop for its leaves. Tobacco is the common name of the plant *Nicotiana tabacum* and to a limited extent of *Nicotiana rustica*. Cigarette tobacco production in Sri Lanka is done by the registered farmers of Ceylon Tobacco Company for a pre-trade agreement. Nitrogen fertilizer plays a crucial role in tobacco production and large and quality production keenly depends on applied nitrogen fertilizer. However, existing nitrogen fertilizer levels have not fully met the yield forecasting and other cost compensating objectives. Therefore, this experiment was conducted to investigate the effect of nitrogen fertilizer level on the nicotine development of flue cured tobacco and to investigate the best application time of fertilizer on the vegetative growth of flue cured tobacco.

Methodology

The experiment was conducted in the selected field of the Ceylon Tobacco Company in Dehiattakandiya during the *Yala* season from April to August 2011. Fifty five days old, uniform quality seedlings of Tobacco from the variety of K326 were used as the planting material. Strip Plot Design was adopted as the experimental design with six treatments and 10 replications. One replicate corresponded to one location; hence the trial was carried out in 10 commercial tobacco fields. It was emphasized that for each treatment using a plot as large as 200 plants and 10 plants of each treatment plot were subjected to data collection. "Yara Milla Complex" is the present recommended fertilizer for tobacco cultivations and it supplies following compositions of macro and micro nutrients for tobacco plants. N: P: K 12:11:18, Zn-0.02%, Mn-0.02%, B-0.015%, S-8%, MgO-2.65%, Fe-0.35%. In this experiment, an additional supplement of nitrogen was given by incorporating different doses of urea to the tobacco plants. Six levels of nitrogen were utilized in the experiment. Tested nitrogen treatments (kg/ha) include 78 (T2), 90 (T3), 100 (T4), 110 (T5), and 120 (T6). Original seeds were used for the seedling production. The nursery period was about 54 days. Ground bed nurseries were used to produce seedlings. The width and length of the nursery bed were about 0.9 m and 4.5 m respectively. One bed was enough for 2000 healthy seedlings. During the nursery period, resetting and clipping was done as the important management practices. The land was ploughed using a disk plough to a depth of 25 – 30 cm. The land was kept for few days to kill grasses and harrowing was done. Then bed preparation was done. The width of the bed was 5 m. Planting beds were irrigated to

moist the land. Replanting was done within 20 days after planting with similar sized seedlings to maintain a uniform plant population. Harvesting was done about 70 days after planting at 7 – 10 day interval. Leaf area, plant height, leaf number, disease severity, final harvestable green leaf yield, cured leaf yield, nicotine level, sugar level and chloride content were recorded. Data were analyzed according to the ANOVA by using SAS computer package.

Results and discussion

It was obvious from the results (Table 1) that there were no significant differences of average plant height among various treatments under test. Maximum plant height (73.42 cm) was produced by T6, which was statistically at par with each other. The other treatments produced comparatively lower plant height. It is evident from the results that plant height increases with the increasing levels of nitrogen from 78 – 119.5 kg/ha. Singh and Sharma (1987) reported that application of 180 kg N/ha resulted in higher plant height. The highest leaf area was related to the fifth treatment (i.e., 110 kg N/ha) and the lowest leaf area was related to the control treatment. An investigation carried out by Gulser (2005) showed that increments in the nitrogen dose from 0 to 150 increased the leaf area and the highest leaf area was obtained at 150 kg N /ha-. These results are consistent with those reported by Demir *et al.* (1996), who also reported that increasing the rate of nitrogen fertilizers increased the leaf area. The results showed that nitrogen fertilizer, when applied up to 85.02 kg N /ha, enhanced leaf growth and photosynthesis, thus increasing leaf area. The effect of different nitrogen levels on leaf area showed that, in the first stages of growth leaf area was low but gradually, by increasing the growth of leaves, the leaf area increased and the difference between treatments could be assessed. The data presented in Table 1 showed that application of 89 kg of nitrogen gave the maximum yield of 2077 kg of cured leaf per hectare which was significantly higher than all other treatments. There was a gradual increase in the cured leaf yield as nitrogen fertilization increased from 85 kg to 110 kg, but beyond 120 kg, the yield significantly decreased showing that 110 kg of nitrogen per hectare was the optimum and ideal dose of nitrogen.

Table 1: Measurement of growth parameters against nitrogen levels

Treatment	Avg. plant height (cm)	Number of Leaves	Avg. leaf area (cm ²)	YPH (Green leaf)	YPH (Cured leaf)	YPH (20000 plants)	Conversion ratio	Income per hectare (Rs)
T1 (Control)	70.074 ^A	20.21 ^A	516.5 ^A	8880 ^A	1532 ^{BC}	2042.7 ^{BC}	5.796	521931 ^{BC}
T2	70.42 ^A	20.60 ^A	522.22 ^A	11061 ^A	1859 ^{AB}	2478.8 ^{AB}	5.949	618216 ^{AB}
T3	71.48 ^A	20.69 ^A	526.26 ^A	10708 ^A	2077 ^A	2769.7 ^A	5.155	694323 ^A
T4	70.72 ^A	20.58 ^A	536.40 ^A	10564 ^A	1752 ^{ABC}	2337.6 ^{ABC}	6.029	590039 ^{ABC}
T5	71.42 ^A	21.1 ^A	554.84 ^A	11257 ^A	1805 ^{ABC}	2408.3 ^{ABC}	6.236	592141 ^{ABC}
T6	73.42 ^A	21.6 ^A	538.28 ^A	9680 ^A	1440 ^C	1920.2 ^C	6.722	479962 ^C

Table 2: Nicotine, Chloride and Sugar contents at different levels of nitrogen

Treatment	Nicotine (%)	Chloride (%)	Sugar (%)
T1 (Control)	2.957 ^A	0.515 ^A	12.375 ^A
T2	3.077 ^A	0.530 ^A	13.150 ^A
T3	2.802 ^A	0.622 ^A	12.475 ^A
T4	2.860 ^A	0.700 ^A	15.025 ^A
T5	2.870 ^A	0.875 ^A	14.325 ^A
T6	2.715 ^A	0.750 ^A	14.650 ^A

*Means that do not share a same letter are significantly different at $p=0.05$

* YPH- Yield per ha

The results were in agreement with those of Colyer and Pholman (1977), Sheikh (1972) and Siddique *et al* (1977). As shown in the Table 2, no significant differences were observed in the nicotine levels produced by control or fertilizer treatments. The fertilizer treatment of 85 kg N / ha produced the maximum nicotine levels (3.077 %). It was followed by N treatment of 78 kg which produced the nicotine level of 2.957 %. The minimum nicotine level (2.715 %) was recorded from the 120 kg nitrogen treatment. No significant differences were observed in the chloride contents produced by control or fertilizer treatments. The fertilizer treatment of 78 Kg N / ha produced the minimum chloride content (0.515 %). It was followed by N treatment of 85 kg which produced the chloride content of 0.53 %. The maximum chloride content (0.875 %) was recorded from the 110 kg nitrogen treatment. It has been investigated that higher the chloride contents, lower the burning quality of tobacco and hence increase in the chloride content does not contribute to produce high quality flue cured tobacco. It is obvious that when nitrogen levels are increasing, chloride contents also get increased, but when it exceeds the nitrogen level of 110 kg / ha, again chloride content tends to be diminished. No significant differences were again observed in the sugar contents produced by control or fertilizer treatments. The fertilizer treatment of 100 kg N /ha produced the maximum sugar contents (15.025 %). It was followed by N treatment of 120 kg which produced the sugar content of 14.65 %. The minimum sugar content (12.375 %) was recorded from the 78 kg nitrogen treatment (control). The overall costs, revenues and profits are given in Table 3.

Table 3: Costs, revenues and profits

Treatment	YPH (kg)	Total Revenue (Rs.)	Marginal Revenue (Rs.)	Total Cost (Rs.)	Marginal Cost (Rs.)	Profit (Rs.)
T1 (Control)	1532	521931	--	61750	--	460181
T2	1859	618216	294.44	62116	1.12	556100
T3	2077	694323	349.11	62374	1.18	631949
T4	1752	590039	-320.87	62896	1.6	527143
T5	1805	592141	39.66	63430	10.08	528711
T6	1440	479962	-307.34	63916	2.79	416046

Conclusions

It is concluded that the growth parameters increased with the increase of nitrogen levels. But when the nitrogen levels exceeded the 110 kg/ha, the growth parameters tend to be decreased vise-versa. The same phenomena can be observed in chemistry with respect to nicotine level, chloride content and sugar content. The optimum Nitrogen level was the 90 kg/ha (Treatment 3) which gave the profit making point (Table 3).

References

Anon, 2011. Cigarettes, British American Tobacco, (Online) Accessed on 2011-07-01, available at :http://www.bat.com/group/sites/uk_3mnfen.nsf/vwpagesWeblive