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EFFECTS OF TOPPING AND SUCKERICIDE ON LEAF QUALITY OF TOBACCO (*NICOTIANA TABACUM)*

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ABSTRACT

Topping stage of tobacco is a key time for development of agriculture measures to promote the quality of leaves. In order to investigating influence of topping timing and suckericide content on tobacco leaf, a factorial experiment on the basis of RCB design with 3 replications was conducted in 2011 at the Tobacco Research Farm of Isfahan. Treatments were including topping time (T_1: topping at early button and T_2: at early flowering), Prim+ content (A_1:8, A_2:10, A_3:12, A_4:14 ml/per plant) and Prime+ concentration (C_1: 1.35%, C_2: 1.5%) are first, second and third factors, respectively. Results showed that, effects of topping timing and Prim+ content were significant for number of suckers, fresh and dry weight of suckers and leaf area of tobacco. Dry weight and leaf length of tobacco were significantly affected by different Prim+ concentrations. Topping at early button resulted in deduction of suckers in tobacco, consequently caused to production of lower sucker weight and higher tobacco leaf area. Moreover, application of higher concentration of Prim+ at early button stage had considerably better effects on sucker growth control and tobacco leaf quality. This result clearly indicated that topping at early growth stage and controlling sucker growth with using suckericide enhanced tobacco leaf quality in the field.

Key words: Dry weight, Leaf area, Topping, Tobacco.

1- INTRODUCTION

To maximize leaf production and encourage leaf-ripening, topping (removal of the flowering head and young leaves) is an essential cultivating measure for air-cured tobacco, which switches the plant from reproductive to vegetative phase (Guo et al., 2011; Gooden et al., 2011; Czubacka et al., 2012). Topping increases the size and weight of leaves, increasing the overall yield per hectare (Singh et al., 2000; Hao and chao yang, 2001; Roton et al., 2005; Reed et al., 2012). Benefits of topping and sucker control include; increased root growth, reduced weight in the top of the plant, a reduction of the translocation of nutrients and moisture from lower leaves to support the growth and development of upper leaves. Increased root growth means an increase in the potential for uptake of water and nutrients, increased support for the upper plant against wind, and an increase in the plant's potential to synthesize nicotine. In addition, topping increases yield through increased growth, especially of the upper leaves. Topping stimulates the production of secondary plant products that accumulate in the leaves (Yi et al., 2006).

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These products give the cured leaf improved quality and smoking characteristics (Hu et al., 2000). Topping is a turning point for nicotine formation and accumulation inside tobacco plant (Hu et al., 2000; Roton et al., 2005; Guo et al., 2011).Topping stage of tobacco is a key time for development of agricultural measures to promote the quality of leaves (Hao et al., 2001; Reed et al., 2012). Late topping increases the number of pretopping suckers that must be removed as well as the chance of plants blowing over in a windstorm. Topping height is another aspect of topping management. Although tobacco plants are typically topped either by hand or mechanically, topping may be accomplished chemically before the emergence of the button and opening of any flowers. Chemical topping would appear to be the ideal method for eliminating the production of excess leaves and the top which will flower. Chemical topping of plants in the pre-button stage eliminates the production of excess leaves and tops which are discarded and do not add to yield of cured leaf. Leaf body can be increased by early chemical topping and redirection of these plant resources. Therefore, the objectives of this research were to understand the influence of topping timing and chemical topping concentration on quality in tobacco by stalk cut under Isfahan climate condition.

2- Materials and Methods

This research was conducted in 2011 at the Tobacco Research Farm of Isfahan, Iranian Tobacco Company (latitude 32°51′N, longitude 51°51′E, altitude 1541 m above sea level). The climate of research area is characterized by mean annual precipitation of 110 mm, mean annual temperature of 4.9°C, mean annual maximum temperature of 24.4 °C and mean annual minimum temperature of 4.2°C. The soil characteristics were shown in table 1.The experiment was arranged as factorial based on RCB design with 3 replications. Topping time (T_1: topping at early button and T_2: at early flowering), Prim+ content (A_1:8, A_2:10, A_3:12, A_4:14 ml/per plant) and Prime+ concentration (C_1: 1.35%, C_2: 1.5%) are first, second and third factors, respectively.

Table 1. Physical and chemical characteristics of soil in 0-30 cm depth

Electrical Conductivity ($ECx10^3$)	Organic Carbon (%)	Total N (%)	Absorbable P (mg/Kg)	Absorbable K (mg/Kg)	Sand (%)	Clay (%)	Silt (%)
4.2	1.14	0.11	16.5	356	61	21	17

Each plot consisted of 5 rows with 4*2m and a density of 60 plants m^{-2}.Tobacco seedlings were transplanted of about 15-22 cm size were uprooted with complete root system for better establishment after transplantation with 40 cm space. Irrigation was applied immediately after transplantation. Further irrigations were carried out with 7 days interval. After transplantation and establishment of the plants and before button stage first sampling was done. Topping was done in each plot and then Prim+ was applied according to treatment levels after topping. Second sampling was done after topping. During samplings number of suckers per plant, fresh weight of suckers per plant, dry weight of suckers per plant, number of leaves per plant, leaf length and leaf width were recorded in each plot. Analysis of variance of the data appropriate to the experimental design and comparison of means at $p \leq 0.05$ were carried out, using MSTATC software.

3- Results and Discussion

3-1- Number of suckers per plant

The analysis of variance of data showed significant effects of topping time and Prim+ content on number of suckers per plant (Table 2). The highest sucker per plant was achieved with topping at flowering stage. Increasing sucker per plant due to topping at flowering stage was 20% more than button stage (Table 3). Topping in the early button stage of plant development is the cultural practice that gives tobacco its desired chemical and physical characteristics that lead to high yields of high quality leaf (Singh et al., 2000). The lowest and the highest suckers were recorded for 14 and 8 ml/per plant, respectively (Table 3). Increasing suckericide content resulted in better cover of plant and reducing new suckers growth. Using suckericide at early stage of vegetative growth at button stage due to decrease in growth of new suckers resulted in more reduction of suckers compared with flowering stage (Kara and Esendal, 1996).These results agree with those reported by Mahadevareddy *et al*. (1990) who concluded that best sucker control and leaf yields were obtained with the use of chemical suckericides.

Table 2. Analysis of variance of the data of tobacco affected by different topping time And Prime+ treatments

		MS				
S.O.V	d.f	Suckers per plant	Fresh weight of sucker	Dry weight of sucker	Leaf width	Leaf length
Replication	2	0.02	1288.1	205.5	3.06	0.39
Topping timing (T)	1	83.6 **	20667 **	4427.5 **	45.04**	31.6^{**}
Concentration (C)	1	0.30	57824	7726.6 **	7.92^{NS}	58.5^{**}
T× C	1	0.02	34133.3 **	461 **	5.67^{NS}	$2.5^{N.S}$
Content (A)	3	4.80 **	18400.1 **	1868.7 **	62.6 **	38.9^{**}
T×A	3	0.01	1059.6^{NS}	124.5^{NS}	1.79^{NS}	$6.13^{N.S}$
C×A	3	0.03	8055.5^{NS}	1058.2 **	16.2 **	1.63^{NS}
T×C×A	3	0.001	1549.6^{NS}	384.4*	3.20^{NS}	12.7*
Error	30	0.12	937.2	120.2	2.24	3.64
C.V (%)	-	152	16	17.1	15.6	12.7

ns, *,**: No significant and significant at $p \leq 0.05$ and $p \leq 0.01$, respectively

Table 3. Means of some morphological parameters of tobacco affected by topping, suckericide concentration and content

Treatment	Number of suckers per plant	Fresh weight of sucker (g)	Dry weight of sucker (g)	Leaf width (cm)
Topping timing				
Button	2.01 [b]	170.5 [b]	54.2 [b]	10.5 [a]
Flowering	2.56 [a]	212 [a]	73 [a]	8.58 [b]
Prim+ Concentration				
1.35	2.37 [a]	226 [a]	76.5 [a]	9.14 [b]
1.5	2.21 [b]	156.5 [b]	51.1 [b]	9.95 [a]
Prime+ content				
8	3.12[a]	246.4[a]	80.1[a]	7.25[b]
10	2.37[b]	191.5[b]	66.9[b]	7.95[b]
12	2.01[bc]	167.1[b]	55.5[bc]	11.1[a]
14	1.64[c]	160[b]	52.7[c]	11.8[a]

Different letters in each columns indicate significant difference at $p \leq 0.05$
T_1 andT_2: topping at button and flowering stages, respectively.
C_1 and C_2: 1.35% and 1.5% of Prime+, respectively.
A_1, A_2, A_3 and A_4: 8, 10, 12 and 14 ml of Prime+, respectively.

3-2- Fresh weight of suckers per plant

Fresh weight of sucker was significantly affected by different time of topping and suckericide content. Interaction of concentration × content was also significant for this trait (Table 2). It can be inferred from the data that the highest fresh weight of sucker plant^{-1} (273.4 g) was recorded in those plots where suckers were manually removed and sprayed with 1.35% of Prim+ at flowering stage (Figure 1). The lowest fresh weight of sucker was also achieved for spraying 1.35% of Prime+ at button stage of topping (Figure 1). Topping stage of tobacco is a key time for development of agricultural measures to promote the quality of leaves (Hao et al., 2001; Reed et al., 2012). Late topping increases the number of pre-topping suckers that must be removed as well as the chance of plants blowing over in a windstorm.

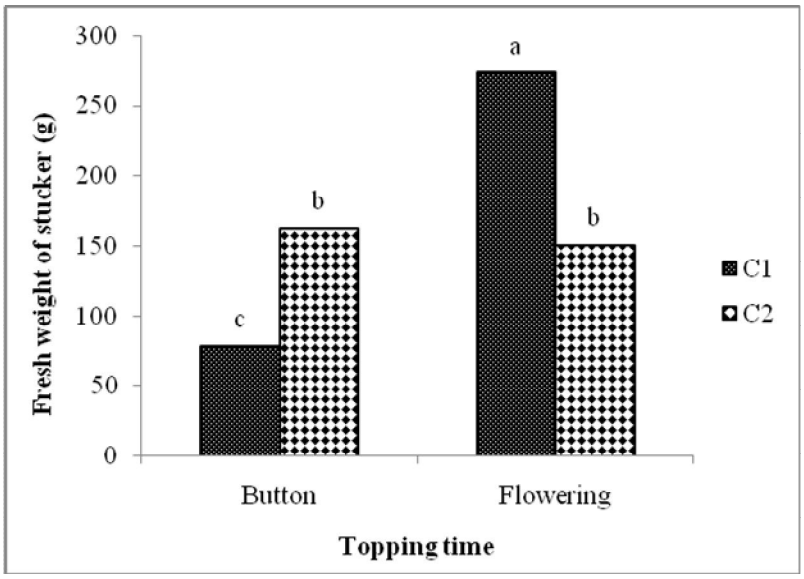

Figure 1. Mean fresh weight of suckers affected by different suckericide concentration and topping time
Different letters indicate significant difference at p≤ 0.05
C_1 and C_2: 1.35% and 1.5% of Prime+, respectively.

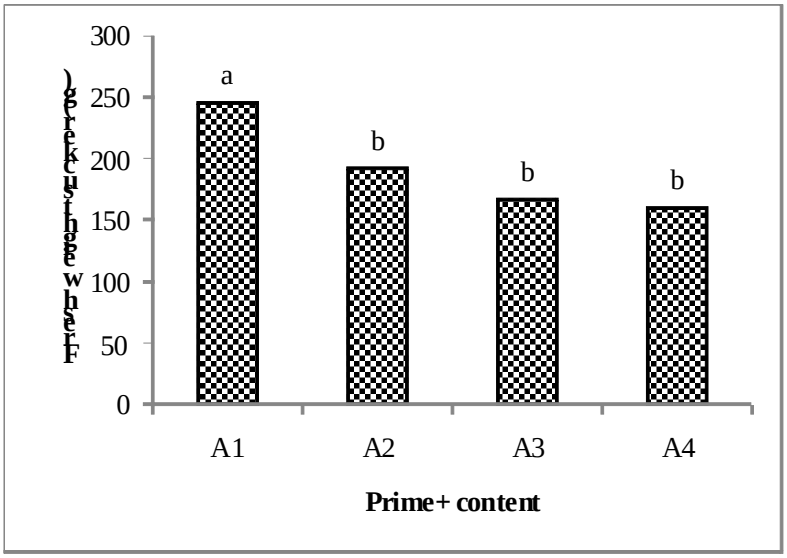

Figure 2. Mean fresh weight of suckers affected by different suckericide content
Different letters indicate significant difference at p≤ 0.05
A_1, A_2, A_3 and A_4: 8, 10, 12 and 14 ml of Prime+, respectively.

The highest and the lowest fresh weight of sucker were recorded for 8 and 14 ml spraying of Prim+, respectively (Figure 2). These results revealed that suckers were completely controlled with the application of suckericide and had thus had provided the plants with more nutrients which otherwise would have been exploited by the suckers and hence decreased fresh weight of suckers plant^{-1}. Similar results are also reported by Gregor*et al*. (1992) who studied that application of C-malic hydrazid alone reduced sucker fresh weight by about 37%.

3-3-Dry weight of suckers per plant

The effects of topping stage, different concentrations and contents of Prime+ on dry weight of suckers per plant were significant. Interaction of topping time× concentration, concentration × content and topping time× concentration × content were also significant for this trait (Table 2). Dry weight of suckers significantly decreased with increasing Prim+ concentration and content. Effect of applying of Prim+ at early stage of button was more efficient than that at flowering stage. In general, dry weight of suckers per plant for topping at flowering stage under all Prim+ application were higher than those under topping at button stage (Figure 3). Delayed topping at flowering stage resulted in significant increase of dry weight of suckers (Figure 3) due to longer growth duration of them on plant, compared with topping at early button stage (Pandeya et al, 2001). Patel *et al.* (1996) investigated that chemical suckericides had a significant effect on suckers control and give minimum dry weight of sucker's plant $^{-1}$.

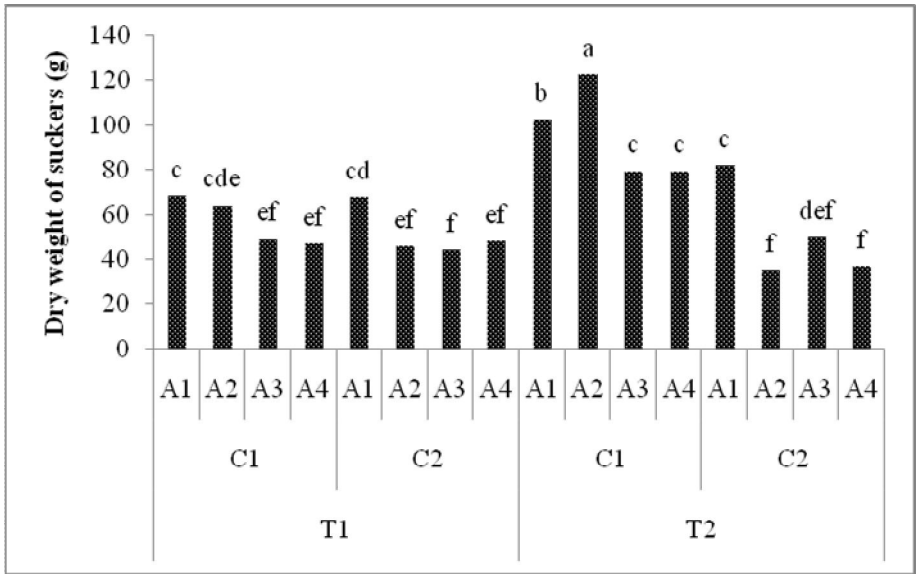

Figure 3. Mean dry weight of suckers affected by different contents and concentrations Of suckericide under different topping stages

Different letters indicate significant difference at $p \leq 0.05$

T_1 andT_2: topping at button and flowering stages, respectively.

C_1 and C_2: 1.35% and 1.5% of Prime+, respectively.

A_1, A_2, A_3 and A_4: 8, 10, 12 and 14 ml of Prime+, respectively.

3-4-Leaf width

Leaf width of tobacco was significantly affected by different time of topping and suckericide content (Table 2). The highest leaf width of 10.52 cm was recorded for plants topped at button stage (Table 3). The interaction of content × concentration for this trait was also significant (Table 2). It is clear that the highest leaf width of 12.8 cm was recorded in plots treated with higher concentration of Prime+ (Figure 4). These results can be related to reduction of sucker's growth as affected by application of higher concentration of suckericide. Similar results are also reported by Bowalska and Lis (1988) who observed that leaf area was higher in plants treated with suckericides.

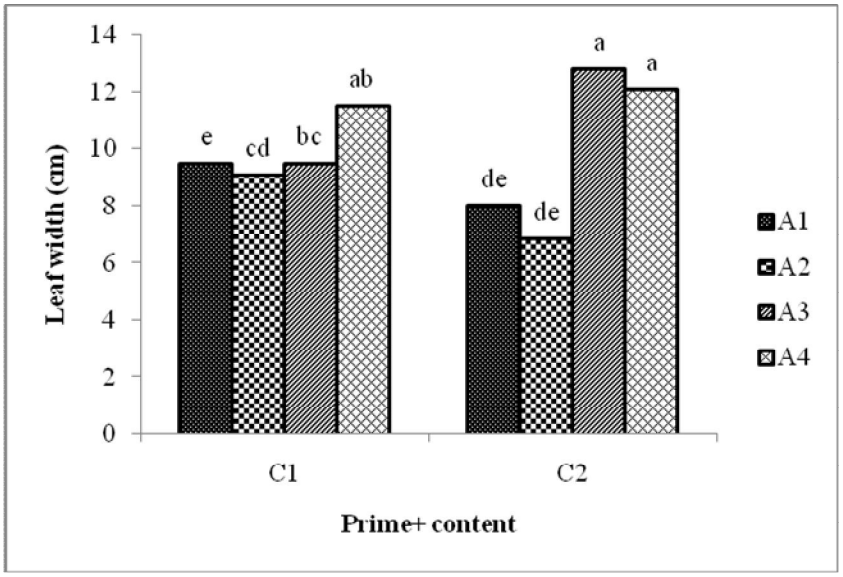

Figure 4. Leaf width of tobacco as affected by different contents and concentrations of suckericide

Different letters indicate significant difference at $p \leq 0.05$

C_1 and C_2: 1.35% and 1.5% of Prime+, respectively.

A_1, A_2, A_3 and A_4: 8, 10, 12 and 14 ml of Prime+, respectively.

3-5-Leaf length

Statistical analysis of the data showed that leaf length was significantly affected by suckers control through different time of topping, suckericide content and concentration. Interaction of topping time× concentration × content was also significant for thus trait (Table 2). Mean values of the data indicated that maximum leaf length of 20 cm was produced by those plots which were sprayed with 14 ml Prim+1.5% followed by plots (17.6 cm) sprayed with 14 ml Prim+ 1.35%. It can be also seen from the data that plots in which suckers were controlled in early button produced considerably higher leaf length in comparison with those plots which suckers controlled at flowering stage. Increasing suckericide concentration also resulted in increase of leaf length of tobacco (Figure 5). Topping stimulates the production of secondary plant products that accumulate in the leaves (Woltz and Mason, 1966; Singh et al., 2000) and consequence timely topping is an important for control suckers.

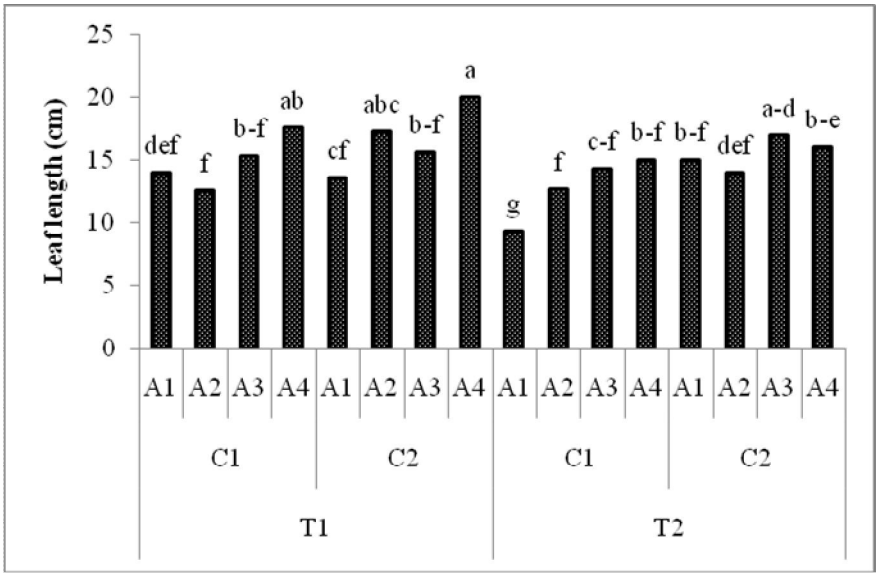

Figure 5. Mean leaf length of tobacco affected by different contents and concentrations Of suckericide under different topping stages

Different letters indicate significant difference at $p \leq 0.05$

T_1 and T_2: topping at button and flowering stages, respectively.

C_1 and C_2: 1.35% and 1.5% of Prime+, respectively.

A_1, A_2, A_3 and A_4: 8, 10, 12 and 14 ml of Prime+, respectively.

CONCLUSION

Results obtained from the present study indicated that, topping stage is the important for yield production in tobacco under Isfahan climate condition. Topping in tobacco is one of the most important operations to improve plant growth, development and quantity. Moreover, application of suckericide in early button stage can control suckers better than flowering stage. In our experiment, topping at early button and spraying with Prim + resulted in better leaf quality of tobacco.

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