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NOTE

Seedling quality of flue-cured tobacco as affected by different types of peat

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ABSTRACT
The direct-seeded float system in greenhouse has received significant attention from tobacco farmers for seedling production. Peat on which seeds germinate is the main part of this system. Peats vary in their origin and processing. The present study was undertaken to determine the effects of different peats on emergence and seedling development of flue-cured Virginia (FCV) tobacco using five peats, one of which was local and the rest were imported. Types of peat significantly affected emergence per tray and fusarium per tray and no significant differences were detected among the peats for the other parameters studied. Local peat was found to be superior over the others with regard to emergence. Therefore, local peat, instead of imported ones, can be used for seedling production in FCV tobacco.
Key Words: *peat; float system; emergence.*

INTRODUCTION

Tobacco (*Nicotiana tabacum* L.) seed needs special environment during emergence because of its small size. For this reason, seeds are not sown directly in the field. Instead, seedbed for seedling production is prepared, seeds are sown on the bed and seedlings are transplanted to the field. Thus, it is possible to shorten the vegetation period and to dry tobacco leaves before early autumn rainfall (Otan and Apti, 1989; Gürbüz, 1994). Therefore, production of ideal seedlings has an important role in tobacco production (Peksüslü and Gencer, 2002).

In conventional tobacco production, the hoot, mild and cold seedbeds have been used for seedling production. A direct-seeded float system in greenhouse (hereafter designated as 'the float system') has been developed as a possible alternative to the conventional methods for seedling production. Today, this is the only seedling production method used in the USA, and 60% of tobacco seedlings are raised using the float system in Brazil (FAO, 2001;

Fowlkes, 2001). The main advantages of the float system are: 1) reduced production cost, 2) environmental factors can be controlled, 3) increased seedling uniformity, and 4) the need for methyl bromide fumigation is eliminated. However, this system also has some disadvantages: the cost for establishing the system is high, more attention is required in comparison with conventional seedbed preparation and the possibility that an ordinary problem can turn easily into a serious one (Peek and Reed 2002; Smith et al., 2002).

The medium and filling of trays are important issues relative to the float system (Peace at al., 2002). In this method, there are three main components of medium used to fill trays: peat, vermiculite and perlit. Peat is the main part that holds water and nutrients for all media. Each medium from different trademarks has a unique mixture of these components. However, as a general rule, the main component is peat (Sales, 2002).

Peat formation occurs after years of degradation/accumulation of underwater vegetation (Şeniz, 1984; Fowlkes, 2001). As peat consists of decomposed plant parts, its peculiarities vary with the plant origin that peat developed from, the degree of decomposition of plant material, mineral content and acidity. As a result, differences among peats from different regions have been observed.

Turkey is rich in natural peat resources; however, peat demand/need for seedling production of different crops, such as vegetables and tobacco, has been supplied mainly by import. Peat used in seedling production is a new issue for Turkish farmers and currently, industries processing raw material for commercial peat have not been fully established. Natural peats have not been evaluated sufficiently in Turkey. If tobacco seedlings can be produced using local peat without quality loss, foreign exchange used for peat importation could be saved. Thus, the aim of this study was to evaluate locally produced commercial peat in the Bolu province of Turkey and four imported peats for their effects on seedling quality of tobacco. To our knowledge, no similar study has been undertaken in Turkey or another tobacco production area of the world. Our goal was to investigate the possibility of using local peats for seedling production in tobacco instead of imported ones to save foreign exchange, and to determine the effects of different peats on tobacco seedling quality.

MATERIALS AND METHODS

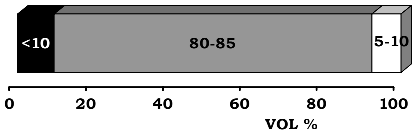
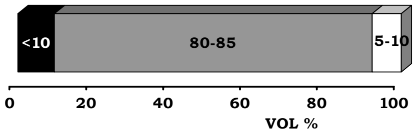
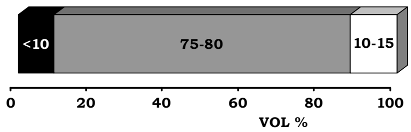
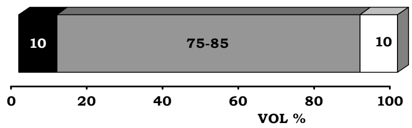
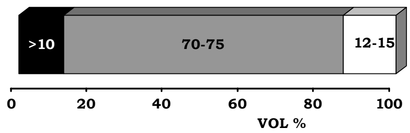
In this study, five different peats were used: Yetkin Torf (1) (the local peat), and Carolinas Choice (2), Potgrond-H (3), Tray Substrat (4) and Potgrond-P (5) imported from Germany. Main chemical and physical properties of peats are shown in Table 1. The experimental design was a randomized complete block with four replications.

Seeds of Flue Cured Virginia (FCV) tobacco (NC 55 type) were sown on the media in four replications in the float system on 21 March 2001. Trays in which seeds were sown had 24×12=288 cells. After sowing one seed per cell, 30 cells were selected for experimental observations. Thus, 4×30=120 seedlings per peat type and a total of 5×120=600 seedlings were evaluated across all five peats. Some observations, such as weed development, failure of seedling emergence, leech and moss development, were made on the basis of a tray as a whole.

The procedures applied in the float system are shown in Table 2. First, the pool had been filled with 2220 L of water and greenhouse covers were opened on 13 April 2001. Salt formation was observed on Yetkin Torf on 30 April 2001 and 10 cc H_2SO_4 per 10 L was added to the pool. Seedlings were clipped four times during the experiment. After clipping, two kinds of pesticide were applied to clipped seedlings. The procedures for clipping and pesticide applications are shown in Table 3. Experimental observations were made on the following traits: emergence, number of seedlings per tray, weed development, fusarium damage, leech damage, root abnormality (spiral root), general seedling development, moss development and leaf index (leaf length/leaf width).

Data from the experiment were subjected to analysis of variance (ANOVA) using MSTAT statistical software. Mean values of abnormal root per tray were normalized using $x' = \sqrt{x} + 1$ transformation before conducting ANOVA (Steel and Torrie, 1980), because no abnormal root was observed in some cases.

Table 1. Main chemical and physical properties and average amount of added nutrients for peats tested.

Chemical data	Average amount of added nutrients	Physical properties
	Potgrond-H	
PH range (H_2O): 5,5 – 6,0	Nitrogen (mg N l^{-1}): 210	
Fertilizer (g l^{-1}): 1.5	Phosphorus (mg P_2O_5 l^{-1}): 240	
Black sphagnum peat: 30%	Potassium (mg K_2O l^{-1}): 270	
White sphagnum peat: 70%	Magnesium (mg Mg l^{-1}): 100	
	Potgrond-P	
PH range (H_2O): 5,5 – 6,0	Nitrogen (mg N l^{-1}): 210	
Fertilizer (g l^{-1}): 1.5	Phosphorus (mg P_2O_5 l^{-1}): 240	
Black sphagnum peat: 30%	Potassium (mg K_2O l^{-1}): 270	
White sphagnum peat: 70%	Magnesium (mg Mg l^{-1}): 100	
	Tray Substrate	
PH range (H_2O): 5,5 – 6,0	Nitrogen (mg N l^{-1}): 210	
Fertilizer (g l^{-1}): 1.5	Phosphorus (mg P_2O_5 l^{-1}): 240	
Black sphagnum peat: 30%	Potassium (mg K_2O l^{-1}): 270	
White sphagnum peat: 70%	Magnesium (mg Mg l^{-1}): 100	
	Carolinas Choice	
PH range (H_2O): 5,5 – 6,0	Nitrogen (mg N l^{-1}): 210	
Fertilizer (g l^{-1}): 1.5	Phosphorus (mg P_2O_5 l^{-1}): 240	
Black sphagnum peat: 30%	Potassium (mg K_2O l^{-1}): 270	
White sphagnum peat: 70%	Magnesium (mg Mg l^{-1}): 100	
	Yetkin Torf	
PH range (H_2O): 5,5 - 6,0		
Fertilizer (g l^{-1}): -	No nutrients added	
Black sphagnum peat: 0%		
White sphagnum peat: 100%		

■ Dry matter ▨ Water capacity □ Air capacity

RESULTS AND DISCUSSION

Results of analyses of variance revealed that the effects of types of peat on emergence per tray and fusarium per tray were significant; however, the same effects on the other parameters tested were non-significant (Table 4). Results from the present study are shown in Tables 5 and 6. The traits/parameters subjected to ANOVA are emergence per tray, fusarium per tray, seedlings exhibiting root abnormality per tray, leaf index, stem diameter and plant height (Table 5). The results for general seedling development, weed damage, moss and leech formation and seedling appearance were visual observations and were not subjected to statistical analyses (Table 6).

Table 2. The procedures applied on pool during experiment.

Procedure	Date and description
Sowing	21.03.2001
Emergence	02.04.2001
pH[a]	7.7+H_2SO_4+NPK (20:20:20)-6.9/Ce=0.8
Magnesium Sulphate application	14.04.2001 460 g per pool
Sulphuric acid application	14.03.2001 25 cc per pool
1. Fertilization[b]	21.03.2001 (with sowing)
2. Fertilization	12.04.2001 (10 days after emergence)
1. General development control	08.04.2001
2. General development control	18.04.2001
3. General development control	27.04.2001
1. Cupravit application for damping-off	20.04.2001 (30 g per 10 L)
2. Cupravit application for damping-off	27.04.2001 (50 g per 10 L)
Metadeks application (brain + sugar + active substance)	27.04.2001 (2 kg)
Ridomil application	30.04.2001 (25 g per 10 L)

[a] pH was adjusted to 6.5-6.8 by using a pH-meter after adding NaOH or H_2SO_4 into pool.
[b] a water-soluble fertilizer consisting of 20% N, 10% P, 20% K, %0.02 B, 0.05% Cu, Mn and Zn, 0.1% Fe and 0.0005% Mo was added to pool twice in 151 g per 100L.

Table 3. Dates for clipping and applying pesticides.

No. of clipping	Plant height (cm)	Date	Pesticide
1st clipping	8	07.05.2001	Cupravit 50 g per 10 L
2nd clipping	10	11.05.2001	Rovral 10 g per 10 L
3rd clipping	11	17.05.2001	Cupravit 50 g per 10 L
4th clipping	11	27.05.2001	Rovral 20 g per 10 L

Each tray used in this study had 288 cells and the number of cells in which emerence occurred was between 218 and 247 (75.7-85.7%, respectively). The analysis revealed that the types of peat had a significant effect on emergence per tray (P<0.01) and the number of seeds that germinated on peat 1 was significantly higher than that on the other peats (247 germinated seeds per tray).

As shown in Table 4, fusarium damage was generally low in all trays and only peat 2 was found to have significantly higher number of fusarium-damaged seedlings (three damaged seedlings per tray). Similarly, the number of seedlings exhibiting root abnormality was low in all trays. Just one tray with one cell exhibited rooting abnormality for peats 3, 4 and 5. The number of cells that exhibited rooting abnormality per tray was 0.25 and found to be statistically non-significant. Although ‘bad’ filling of trays has been reported to cause abnormal root induction by some researchers, the reasons for rooting abnormality have not yet been clarified (Reed, 1998).

Table 4. Results of variance of analysis for mean values of parameters tested.

Source of variation	Degrees of freedom	Sum of squares	Mean square	F value
Emergence per tray				
Block	3	9.800	3.267	0.7582
Peat kinds	4	2468.700	617.175	143.2515**
Error	12	51.700	4.308	
CV (%): 0.92				
Fusarium per tray				
Block	3	1.146	0.482	2.1721
Peat kinds	4	18.622	4.655	20.9865**
Error	12	2.662	0.222	
CV (%): 4.78				
Abnormal root per tray				
Block	3	0.012	0.004	0.4369
Peat kinds	4	1.168	0.392	1.649ns
Error	12	2.128	0.177	
CV (%): 1.21				
Leaf index				
Block	3	0.003	0.001	0.344
Peat kinds	4	0.025	0.006	2.001ns
Error	12	0.040	0.003	
CV (%): 1.38				
Stem diameter				
Block	3	0.012	0.004	0.4898
Peat kinds	4	0.082	0.020	2.5102 ns
Error	12	0.098	0.008	
CV (%): 1.51				
Plant height (before second clipping)				
Block	3	0.004	0.001	0.0260
Peat kinds	4	2.348	0.587	3.3352 ns
Error	12	2.616	0.176	
CV (%): 1.96				
Plant height (before third clipping)				
Block	3	0.282	0.094	0.3170
Peat kinds	4	3.578	0.894	3.0169 ns
Error	12	3.558	0.296	
CV (%): 3.98				

^{ns} not significant; ** Significant at the 0.01 probability level.

Peat 1 produced lower values of leaf index than the other peat types; however, the difference was found to be non-significant. Similarly, peat types did not affect stem diameter. Plant height was measured twice and it was found to be between 11.1-12.1 cm before the second clipping and 13.1-14.0 cm before the third clipping. Data analyses revealed no significant peat effect on plant height, either.

Data for general seedling development indicated that one tray was homogeneous and three trays were not homogeneous for peats 1, 2 and 5; three trays were homogeneous and one tray was not homogeneous for peat 3; and two trays were homogeneous and two trays were not homogeneous for peat 4. Thus, peat 3 was more homogeneous than the others. Similarly, weed development was observed on all peats except peat 1.

Table 5. Mean values of emergence, fusarium and abnormal root per tray, leaf index and plant height in flue-cured tobacco affected by different peat kinds.

Peats	ET	FT	AT	LI	SD	PH1	PH2
Yetkin Torf (1)	247a**	1.0b	-	1.29	5.9	11.8	13.3
Carolinas Choice (2)	219c	3.0a	-	1.32	6.0	11.1	14.3
Potgrond-H (3)	225b	1.0b	0.25	1.36	6.0	11.1	13.2
Tray Substrat (4)	216c	0.27b	0.25	1.38	6.1	12.1	13.7
Potgrond-P (5)	220c	0.5b	0.25	1.38	6.0	11.6	14.0

ET: emergence per tray; FT: fusarium per tray; AT: abnormal root per tray; LI: leaf index; SD: stem diameter (mm); PH1: plant height (cm, before second clipping); PH2: plant height (cm, before third clipping).
** Values followed by different small letters in each column are significantly different at the 0.01 probability level according to Duncan Multiple Range test (LSD for ET = 4.483; LSD for FT = 1.018).

Table 6. Seedling development, general seedling appearance, moss, weed and leech formation for each peat tested.

Peats	Trays (replications)	Seedling development	Weed	Moss	Leech	Seedling appearance
Yetkin Torf	1	Homogenous	-	Few	-	Good
	2	Not homogenous		Present but drying	-	Good
	3	Not homogenous		Present but drying	-	Good
	4	Not homogenous		Present	-	Good
Carolinas Choice	1	Homogenous	Few	-	-	Good
	2	Not homogenous		-	-	Weak (on tray margins)
	3	Not homogenous		-	-	Good
	4	Not homogenous		-	-	Weak (on tray margins)
Potgrond-H	1	Homogenous	Few	Excessive	-	Good
	2	Homogenous		Excessive	-	Good
	3	Homogenous		Excessive	-	Good
	4	Not homogenous		Excessive	-	Weak (on tray margins)
Tray Substrat	1	Homogenous	Few	Excessive	-	Good
	2	Not homogenous		Excessive	Few	Weak (on tray margins)
	3	Homogenous		Excessive	-	Good
	4	Not homogenous		Excessive	Few	Weak (on tray margins)
Potgrond-P	1	Homogenous	Few	Excessive	-	Good
	2	Not homogenous		Excessive	Few	Weak (on tray margins)
	3	Not homogenous		Excessive	-	Good
	4	Not homogenous		-	Few	Weak (on tray margins)

Moss formation on the surface of trays is an important factor affecting seedling development. In this study, moss formation was observed on peats 1, 3, 4 and 5, whereas no moss occurred on peat 2. This suggested that especially peats 3, 4 and 5 were vulnerable to moss invasion. Also, leech damage was detected for peats 4 and 5 to a limited degree.

At the end of the development period, seedlings looked healthy and only a few growing on the tray margins had poor appearance. In general seedling appearance, peat 1 was found to be the best. For peats 2, 4 and 5, two trays had weak seedlings on their margins, and for peat 3, just one tray had weak seedlings on the margins.

CONCLUSIONS

This study indicated that the effects of types of peat on emergence per tray and fusarium per tray were significant, however the same effects on the other parameters tested were non-significant and local peat was superior to the imported ones with regard to seedling emergence. Thus, imported peats did not show any superiority over the local peat. Because approximately US$2.5 million per annum are reportedly spent for peat importation in Turkey (Anonymous, 2006), it is important to use local peat instead of imported ones for seedling production to avoid economic losses to Turkey. We suggest that there would be no need to import peat as local peat can be used for seedling production safely and effectively. However, it should be noted that the present data are preliminary and further studies are needed to confirm the results.

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