CRITICAL PERIODS OF WEED COMPETITION IN COTTON

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ABSTRACT

In the 2002 – 2003 periods, in PSI Institute of Southern Crops in Strumica, there were conducted examinations to confirm the presence of late spring weeds in cotton (*Gossypium hirsutum* L.) and the critical periods for their evolvement. The presence of weeds for more than three weeks after crop emergency caused significant reductions in crop growth and lint yields. However, weeds that emerged 11 weeks after crop emergence did not adversely affect yields. Total weed biomass increased with increasing time prior to weed removal. A weed-free period of 11 weeks after crop emergency was needed to prevent significant reductions in cotton height, biomass, number of squares and yield. These results indicated that post-emergency herbicides or other control measures should be initiated within two weeks after crop emergency to avoid significant yield reduction. For grater efficiency, soil-applied herbicides in cotton should provide effective weed control for at least 11 weeks.

Keu words: Weed; weed competition; cotton.

КРИТИЧНИ ПЕРИОДИ ВО КОМПЕТИЦИЈАТА НА ПЛЕВЕЛИТЕ И ПАМУКОТ

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Краток извадок

Во периодот од 2002 и 2003 година во ЈНУ Институт за јужни земјоделски култури - Струмица беа изведени испитувања за да се утврди присуството на касно пролетните плевели кај памукот (Gossypium hirsutum L.) и критичните периоди во отстранувањето на истите. Присуството на плевелите повеќе од три недели по појавата на посевот предизвикаа значајни намалувања во порастот на културата и промени во производството. Плевелите што се појавија 11 недели по појавата на памукот немаа негативно влијание врз производството. Тоталната биомаса на плевелите се зголеми со зголемувањето на времето до отстранувањето на истите. За да се заштитат значајните промени во висината на памукот, биомасата, бројот на плодовите и родот, е потребно време од 11 недели без плевели по појавата на посевот. Овие резултати покажуваат дека третирањето со хербициди и други контролни мерки треба да се превземат две недели по појавата на посевот за да се избегнат значајни намалувања во производството. За поголема ефикасност, почвено аплицираните хербициди на памукот треба да обезбедат поефикасна плевелова контрола за најмалку 11 недели.

Клучни зборови: Плевел; плевелова компетиција; памук.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is very important crop in the world as of its spreading area as well as its economic meaning like a common fiber-giving culture and important pre-culture for the other cultures.

In Macedonia cotton is grown on 569 ha in 1987 (Klimov 1990), with average 1500 kg/ha.

If there can be afforded good conditions for a full cotton growth there can be expected a high yield of cruel cotton.

One of the most important factors in the cotton growth is the weeds. They have significant competition influence of the cotton growth. Yield reduction depends on the weed species, density and distribution as well as on the soil's moisture, temperature, type, fertility and pH.

The duration of weed presence with the crop and the time of weed emergence, generally affect weed-crop competition. The critical period of weed-crop competition occurs when both the weeds and crop are in the same vegetate stage of growth. This period of weed-cotton competition varies from three to 9 weeks after sowing, and depends on environmental factors and those related to both crop and weeds. Buchanan and McLaughlin (1975) reported that cotton – in two locations in Alabama – tolerated 4-7 weeks of weed competition after crop emergence. However, some researchers found that a 4-5 week weed-free period was needed for cotton growth to be unaffected. These differences could be attributed mainly to different density and species of the weeds present, as well as to environmental factors.

Cotton yield was the most sensitive measurement of growth in response to weed competition, spatial arrangement of weeds, weed species and density. Topalov, V. (1973) reported that with 40-135 weeds/m^2 cotton yield reduces even to 99%. He also reported (1976) that with late first tillage cotton yield is reduced to 90%. However, although the late emerged weeds do not reduce the yield, they interfere at harvesting and there is lowered crop quality.

The above-mentioned studies were carried out in USA and in Bulgaria, but the similar studies have not been conducted with the cotton under field conditions in Macedonia. There why**, the objective of this research was to determine the effect of weed removal and weed emergence time on cotton growth in Macedonia.**

MATERIALS AND METHODS

The experiments were conducted in field and laboratory conditions. The field trials were established in PSI Institute of Southern crops in Strumica, Macedonia, started in 2002 and lasted until 2003.

The most common weeds in the experimental area were *Chenopodium album* with 14% of all area and *Amaranthus retroflexus.*with 65%. Other weeds present were *Amaranthus albus, Setaria verticillata, Echinochloa crus-galli* and *Xanthium strumarium.*

Soil was prepared according to the local practice for cotton production. It was sowed type "Strumica 105" in May, exactly on 10. 05. 2002 and on 12. 05. 2003. The crop was irrigated as necessary to sustain growth.

Two of four experiments were carried out to evaluate the effect of the time of weed removal on cotton growth and two other experiments were conducted to determine the influence of time of weed emergence on cotton growth. In the weed removal trials, weeds were allowed to compete with cotton for 3, 5, 7, 9, 11 and 13 weeks after crop emergence. Weeds were removed by hands and plots remained weed-free for the duration of the season until harvest. In the weed emergence experiments, plots were maintained weed-free manually for 3, 5, 7, 9, 11 and 13 weeks and then left unweeded for the rest of the growing season. In each experiment, two control treatments were included: a season-long weed-free treatment and a season-long natural infestation of weeds.

The experimental design consisted of a randomized complete block with four replication for each treatment. Each plot consisted of six cotton rows (70 cm apart), 6m long. The adjacent two rows of each plot were used as guard rows.

In all trials, height and biomass of cotton plants were determined at the time of each weed removal or emergence. Four cotton plants were harvested at ground level from a 35-cm-long row in each plot. A central area of two cotton rows x 2.5 m long was left undisturbed for the final yield harvest assessments. Number of squares of cotton plants was recorded at 11 and 13 week after crop emergence. All cotton assessments were performed on the central two rows of each plot. At harvest (22 weeks after crop emergence), cotton was hand-harvested from the plants in the two central rows (2 rows x 2.5 m long) in each plot and yield of seed cotton was determined.

Assessments of weed density and biomass were performed at each time of removal on samples collected from $1m^2$ in the two central rows of each plot. Weed density and biomass assessments were also performed near harvest in experiments on weed emergence time. At each assessment, plants of each weed species separately were cut at ground level, measured, dried at 70°C for 48 h, and dried biomass was determined.

RESULTS AND DISCUSSION

Time of weed removal Height, biomass, square number and yield of cotton plants grown with weeds were reduced with prolonged delays in weed removal in both 2002 and 2003. However, the impact of weeds on cotton growth was not proportional with time (Table 1). The reduction of these growth parameters was grater in cotton plants grown during 2002 than during 2003, mainly because more weeds were present in 2002.

Total biomass in both growing seasons increased with increasing time of weed removal, but this increase was not proportional with time (Table 2). Weed biomass in 2002 was 40% higher than in 2003. Weed density counts in all plots showed that the mean total density ranged from 195 to 280 plants on m^2.

Table 1. Effect of wwed removal time on height (cm), biomass (g plant), square (number plant) and yield (% of weed-free) losses of cotton plants grown in 2002 and 2003

Cotton	Weeks after crop emergence						
	0	3	5	7	9	11	13
2002							
Height	70,9	66,8	49,8	29,1	22,3	18,9	20,6
Biomass	43,5	38,0	21,4	4,5	1,2	0,8	0,6
Squares	18,2	16,4	10,2	3,1	0,1	0	0,1
Yield	0,0	8,0	13,0	70,0	96,0	100,0	100,0
2003							
Height	60,1	59,5	54,8	49,1	47,3	45,3	42,5
Biomass	35,0	32,6	25,0	18,0	13,1	12,5	11,4
Squares	12,7	12,4	10,5	8,3	6,3	5,4	5,0
Yield	0,0	13,0	23,0	55,0	81,0	87,0	100,0

The lack of cotton height reduction in plots where weeds were present for 3-5 weeks (Table 1) is in agreement with results obtained by other scientists. Topalov, V. (1976), reports that weed emergence from 1-60 plants on one m^2 the cotton height until flower significantly reduces from 12-23 cm.

The significant reduction of cotton biomass at the early growth stages was expected, because of the fast plant growth rate of Chenopodium album, Amaranthus spp. and Setaria verticillata. During the first 3-4 weeks, these weed plants grew faster, became taller than cotton plants, and maintained that growth throughout the growing season. The number of cotton squares was alsoreduced by the presence of weeds for the first 5 weeks (Table 1).

Cotton yield in weed-free plots was higher in 2003 (3900 kg/ha), than in 2002 (2850 kg/ha). However, in competition weeds for the first 3 weeks, yield of cotton plants in 2002 and 2003 was reduced significantly, by 8% and 13%, respectively, in comparison with that of weed-free control (Table1). The severe cotton yield loss with increasing time of weed interference from five to 9 weeks after crop emergence is in agreement with the findings of other researchers.

Table 2. Total biomass of weeds (g/m^2) growing with cotton in 2002 and 2003, as affected by removal or emergence time

Time of Weed:	Weeks after crop emergence						
	0	3	5	7	9	11	13
Removal							
2002	0	100	500	900	1450	2000	2400
2003	0	40	360	560	1080	1160	1440
Emergence							
2002	2400	1650	1050	650	470	200	50
2003	1440	1340	850	400	320	120	40

The total weed biomass increase with increasing time before weed removal was due to the longer period the weeds grew. Their density decreased during the same time, due possibly to both interspecific and intraspecific competition among the weed species present at high densities. The higher total weeds biomass recorded in 2002 than in 2003 could be attributed to the higher weed density in the former growing season.

Time of weed emergency Height, biomass and yield of cotton plants increased with increasing duration of the weed-free period in both growing seasons, but their increase was not proportional with time (Table 3). The reduction in these growth parameters was greater in cotton plants grown during 2002 than in 2003.

Table 3. Effect of weed emergence time on height (cm), biomass (g plant), squares (number plant) and yield loss (% of weed-free) of cotton plants grown in 2002 and 2003

Cotton	Weeks after crop emergence						
	0	3	5	7	9	11	13
2002							
Height	16,0	32,4	51,5	55,1	60,5	63,5	71,4
Biomass	0,3	2,4	27,3	28,4	33,8	38,8	41,5
Squares	0,0	1,0	9,6	9,4	13,1	16,0	17,9
Yield loss	100,0	100,0	39,0	26,0	14,0	2,0	0,0
2003							
Height	44,2	50,3	50,7	55,8	58,4	58,9	59,4
Biomass	11,2	14,0	15,5	19,7	27,7	28,7	34,9
Squares	4,1	6,5	7,7	9,4	11,9	12,2	13,0
Yield loss	100,0	88,0	62,0	29,0	18,0	10,0	0,0

Total weed biomass in both growing seasons decreased with increasing duration of the weed-free period (Table 2). Weed density during the same period followed a similar trend to that of weed biomass. Moreover, the total weed biomass in 2002 growing season was grater than in 2003.

These findings show that the late-germinating weeds compete with the crop less severely than do weeds emerging earlier.

The yield of cotton plants grown in plots kept weed-free for 11 weeks during 2002 and 2003, was reduced by 2% and 10% respectively, in comparison with that produced in 100% weed-free plots (Table 3). The corresponding yield reduction in plots kept weed-free for 3 weeks was 100% and 88%. Cotton yield, in accordance with the other growth parameters, also decreased with decreasing duration of the weed-free period after crop emergence. Again, grater yield reduction was recorded with cotton plants grown in 2002 than in 2003. Additionally, cotton yield reductions were grater where weeds emerged earlier and competed with the crop for longer periods.

The weed density reduction with increasing duration of the weed-free period was related to species emergence pattern. For example, Chenopodium album and Amaranthus spp., the most common weed species found in these trials, germinate in May, when cotton is emerging. These weeds contributed an appreciable amount of the weed biomass. Total weed biomass decreased with duration of the weed-free period. This reduction was due to fewer weeds, which emerged later and had a shorter period of growth. All of this reduced their ability to produce biomass in comparison with weeds that emerged earlier and were allowed to compete with cotton for a long time.

CONCLUSION

- These findings showed clearly that cotton-weed competition starts 3-5 weeks after crop emergence. Thus, weed management inputs should be implemented at that time and must be continued for 11 weeks after crop emergence in order to avoid a reduction in cotton growth and yield.
- Weed management in cotton should include one or more of following: soil-applied herbicides, cultivation, hand weeding and/or post emergence herbicides for at least 11 weeks to maximize cotton yield potential. Cotton growers should take into consideration that their post emergence herbicide application or mechanical means in combination with hand weeding, must be performed within the first 4 weeks after crop emergence, in order to achieve a weed-free environment for optimal cotton growth.

REFERENCES:

1. Buchanan, G.A. and McLaughlin, R.D. (1975) Influence of nitrogen on weed competition in cotton. *WeedSci*. 23:324-328.
2. Klimov, S. Gjorgjevski, J. (1990) : Industriski kulturi, (osnoven ucebnik), Univerzitet " Sv. Kiril i Metodij" - Skopje.
3. Kojić, M., Šinžar, B. (1985): Korovi, Naućna knjiga - Beograd.
4. Popov, B. (1964): Pamukoproizvodstvoto vo Jugoslavija, Institut za pamuk, SRM - Strumica.
5. Topalov, V. (1973) : Novi aspekti v borbata s plevelite pri pamuka, Rastitelna zasita - Sofiя.
6. Topalov, V. (1976) : Sъvremenno sъstoяnie na problema za plevelite pri pamuka i borbata s tяh, Selekciя i agrotehnika na pamuka, 119-126 - Sofiя.
7. Topalov, V. (1979): Plevelite i borbata s tяh, Promisleni tehnologii v pamukoproizvodstvoto. Plovdiv, Izd. Xr.G. Danov.
8. Topalov, V. (1981): Optimizaciя na borbata s plevelite v pamukoproizvodstvoto, Sb. Intenzifikaciя I promi[leni tehnologii v pamukoproizvodstvoto, - Sofiя.
9. Topalov, V. (1986): Pragove na vrednost na plevelite I racionalni sistemi za borba s tяh pri intenzivnoto pamukoproizvodstvo, (Avtoreferat na disertaciя za polucavane na naucnata stepen) Doktor na selskostopanskite nauki - Sofiя