MOISTURE IN DIFFERENT SOIL LAYERS DEPENDING ON WEED DENSITY IN COTTON

ВЛАЖНОСТ В РАЗЛИЧНИТЕ ПОЧВЕНИ СЛОЕВЕ В ЗАВИСИМОСТ ОТ ЗАПЛЕВЕЛЯВАНЕТО ПРИ ПАМУКА

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ABSTRACT

The main competitors of cotton during the crop production are annual late-spring weeds with some perennial species representing the second most important group. During the 1999-2001 period the effect of 3 main weed species – namely Solanum nigrum L., Amaranthus retroflexus L. and Convolvulus arvensis L. on the soil moisture in 3 layers (0-10, 20-20 and 20-30 cm) was studied at the Cotton and Durum Wheat Research Institute in Chirpan. Seven variants of increasing population density of different species were evaluated and the moisture content of the soil was calculated by weighing samples in the phases of square formation, flowering and maturity of the crop. Two-factor dispersion analysis (ANOVA) was used to determine the significance of the differences between treatments. Soil moisture content was found to be affected at two stages (flowering and maturity) by both weed density and soil layer. In the phase of square formation no differences were observed between moisture content of the three studied soil layers (0-10, 10-20 and 20-30 cm).

Key words: moisture in different soil layers, weeds, cotton

РЕЗЮМЕ

Памукът се заплевелява главно от едногодишни късно-пролетни плевели и някои многогодишни видове. През периода 1999-2001 г. в Института по памука и твърдата пшеница –Чирпан, бе проучено влиянието на 3 основни плевела – Solanum nigrum L.; Amaranthus retroflexus L. и Convolvulus arvensis L., върху влажността в 3-те почвени слоя – 0-10, 10-20 и 20-30 cm. Заложени са 7 варианта с повишаващи се плътността на отделните плевелни видове, като влажността е отчетена по тегловния метод във фазите бутонизация, цъфтеж и узряване на памука. Получените данни са анализирани чрез двуфакторен дисперсионен анализ (ANOVA). Установено е, че във фазите цъфтеж и узряване има доказаност на разликите в почвената влажност, както между нивата на заплевеляване, така и между проучваните 3 почвени слоя. Във фаза бутонизация няма значимо различие във влажността на почвените слоеве от 0 до 30 cm.

Ключови думи : влажност в различни почвени слоеве, плевели, памук

INTRODUCTION

Cotton is a valuable technical crop. One of the main unfavorable factors limiting the cotton yield and quality are weeds [1,3]. It was established that in the last 20 years there was an increase in the density of the following species – common amaranth (Amaranthus retroflexus L.), black nightshade (Solanum nigrum L.), and among the perennials – bindweed (Convolvulus arvensis L.) [2].

The objective of the research was to study the effect of the different density of the three weeds on moisture in different soil layers – from 0 to 30 cm in the three phases of cotton development – square formation, flowering, and maturity.

MATERIAL AND METHOD

In the period 1999-2001 at the Cotton and Durum Wheat Research Institute in Chirpan a field micro experiment, under dry conditions, on a Eutric vertisols , and with cotton – cultivar Chirpan 539, was carried out. The experiment included 7 variants with different weed density - Amaranthus retroflexus L. – 1, 2, 4, 8 weeds/m^2, Solanum nigrum L.- 1, 2, 4 и 8 weeds/m^2 и Convolvulus arvensis L. – 1 ,2 ,4 weeds/m^2. The experiment was carried out in four repetitions following the block method, with test plot size of 1 m^2.

The exact number of weeds in the different variants was kept by means of manual removal of the excessive sprouts and shoots of other species during the entire vegetation period of cotton. For a single sample of Convolvulus arvensis L, 1 weed stem together with the offshoots coming out from the soil were counted for.

The moisture in the soil layers 0-10 cm, 10-20 cm, and 20-30 cm was determined following the weighing method in three phases of cotton development – square formation, flowering, and maturity, by means of drying of the soil at temperature of 105 ^{0}C until absolutely dry mass was obtained [4].

The application of the two-factor dispersion analysis (ANOVA) allowed the estimation of the differences in the

Таблица 1. Доказаност на разликите във влажността на почвата между различните комбинации на вариантите на заплевеляване и дълбочините на анализирания почвен слой
Table 1. Verification of the differences in soil moisture with respect to the different combinations of the variants of weed density and the depth of the analyzed soil layer

Варианти Variants **Брой плевели на 1 m^2 Weeds number/m^2**	**Дълбо-чина на почв. слой (cm) Depth of soil layer(cm)**	Бутонизация (Square formation)			Цъфтеж (Flowering)			Узряване (Maturity)		
		$\bar{x}$	**D**	**Дока-за-ност Verifi-cation**	$\bar{x}$	**D**	**Дока-за-ност Verifi-cation**	$\bar{x}$	**D**	**Дока-за-ност Verifi-cation**
1.Чист от плевели - 0	0 - 10	25,03			19,86			18,16		
Without weeds	10- 20	24,36	-0.67	ns	19,03	-0,83	-	17,66	-0,50	ns
	20 - 30	23,13	-1,9	ns	18,20	-1,66	---	17,16	-1,00	--
2.Convolvulus arvensis-1	0 - 10	23,33	-1,7	ns	19,00	-0,86	--	17,70	-0,46	ns
Solanum nigrum-1	10 - 20	22,13	-2,9	ns	18,03	-1,83	---	17,20	-0,96	--
Amar.retroflexus-1	20 - 30	21,80	-3,23	ns	17,83	-2,03	---	16,76	-1,4	--
3. Convolvulus arvensis -1	0- 10	22,73	-2,3	ns	18,50	-1,36	---	17,36	-0,8	-
Solanum nigrum-2	10- 20	21,80	-3,23	ns	17,93	-1,93	---	16,76	-1,4	--
Amar.retroflexus-2	20 - 30	21,40	-3,63	ns	17,56	-2,3	---	16,43	-1,73	---
4. Convolvulus arvensis -1	0 - 10	22,00	-3,03	ns	17,96	-1,9	---	16,70	-1,46	---
Solanum nigrum-4	10 - 20	21,26	-3,77	ns	17,20	-2,66	---	16,33	-1,83	---
Amar.retroflexus-4	20 - 30	20,96	-4,07	ns	16,93	-2,93	---	15,90	-2,26	---
5. Convolvulus arvensis -2	0 - 10	21,56	-3,47	ns	17,63	-2,23	---	16,30	-1,86	---
Solanum nigrum-4	10- 20	20,90	-4,13	ns	16,70	-3,16	---	15,80	-2,36	---
Amar. retroflexus-4	20 - 30	20,33	-4,7	ns	16,26	-3,60	---	15,26	-2,90	---
6. Convolvulus arvensis -2	0 - 10	20,93	-4,1	ns	17,00	-2,86	---	15,56	-2,60	---
Solanum nigrum-8	10- 20	20,30	-4,73	ns	16,16	-3,70	---	15,06	-3,10	---
Amar.retroflexus-8	20 - 30	19,00	-6,03	--	15,13	-4,73	---	14,53	-3,63	---
7. Convolvulus arvensis -4	0 - 10	20,06	-4,97	-	16,16	-3,1	---	15,10	-3,06	---
Solanum nigrum-8	10- 20	19,56	-5,47	-	15,63	-4,23	---	14,40	-3,76	---
Amar. retroflexus-8	20 - 30	19,16	-5,87	--	15,16	-4,70	---	14,10	-4,06	---
		gD $_{5\%}$ = 4,75 gD $_{1\%}$ = 5,66 gD $_{0,1\%}$ = 6,24			gD $_{5\%}$ = 0,63 gD $_{1\%}$ = 085 gD $_{0,1\%}$ = 1,11			gD $_{5\%}$ = 0,60 gD $_{1\%}$ = 0,81 gD $_{0,1\%}$ = 1,06		

Табл. 2 Доказаност на разликите във влажността в зависимост от дълбочината на анализирания почвен слой във фазите бутонизация, цъфтеж и узряване, средно за периода
Table 2. Verification of the differences in soil moisture depending on the depth of the analyzed soil layer in the phases of square formation, flowering, and maturity, with average values for the period

Варианти Variants / Depth of soil layer (cm)	Бутонизация (Square formation)			Цъфтеж (Flowering)			Узряване (Maturity)		
	$\bar{x}$	D	Дока-за-ност Verifi-cation	$\bar{x}$	D	Дока -за-ност Verifica-tion	$\bar{x}$	D	Дока-за-ност Verifi-cation
0-10 cm	22,23			18,06			16,7		
10-20 cm	21,47	-0,76	ns	17,24	-0,82	---	16,17	-0,53	---
20-30 cm	20,95	-1,28	ns	16,81	-1,25	---.	15,73	-0,97	---
	gD 5% = 1.84 gD 1% = 2.45 gD 0,1% = 3.23			gD 5% = 0,39 gD 1% = 0,51 gD 0,1% = 0,67			gD 5% = 0,24 gD 1% = 0,32 gD 0,1% = 0,42		

soil moisture for the variants of weed density, as well as the differences in moisture depending on the depth of the studied soil layer. The analyses were carried out separately for each of the development phases.

The 1999-2001 period included years with different temperature and rainfall characteristics. Most favorable for cotton was 1999, while the conditions in 2000 and 2001 were comparatively unfavorable. The amount of rainfall during the three years of the experiment exceeded the average values for the multiyear period.

RESULTS AND DISCUSSION

The analysis of the obtained results showed that for the 3-year study period the highest soil moisture was recorded, on the average, in variant 1 – without weeds. The values of this index in the phase of square formation of cotton in the surface layer 0-10 cm was ($\bar{O}$ = 25,03), followed by the moisture in the layer 10-20 cm ($\bar{O}$ = 24,36), and by that in 20-30 cm ($\bar{O}$ = 23,13). At weed density with Amarantus retroflexus and Solanum nigrum L. from 1 weed/m^2 to 8 weeds/m^2 , and with Convolvulus arvensis – from 1 weed/m^2 to 2 weeds/m^2, the moisture in the soil layers up to 30 cm decreased to 20,3%, but the difference from the basic control was not verified – tab.1. With the increase of the bindweed density to 4 weeds/m^2 (var.7), the soil moisture was proved to decrease to 19,16%.

The strongest effect of the weed density on this index was recorded in the phase of flowering of cotton. Even in the case of the lowest weed density – 1 weed/m^2 – the moisture in the three soil layers – 0-10 cm, 10-20cm, and 20-30 cm, was strongly reduced, a fact which was statistically proved. The high weed density reduced considerably the soil moisture to 4,7%.

In the phase of maturity the results were similar to those obtained in the flowering phase. Moisture in the different soil layers decreased to 4,06% and this fact was statistically proved. The only exception was observed with respect to variant 2 – at low weed density moisture in the soil surface layer was slightly reduced, which was not verified mathematically (tab.1).

The results in table 2 show the differences with respect to moisture depending on the depth of the studied soil layer in the phases of square formation, flowering, and maturity. The three weed species, irrespective of the studied density, reduced the moisture, but in the earliest phase of the cotton development – square formation – no statistically proved differences with respect to the different soil layers were recorded. In the other two phases – flowering and maturity – the soil moisture in the layers 10-20 cm and 20-30 cm decreased, and this was statistically proved. The lowest moisture degree was recorded in the phase of maturity ($\bar{O}$ = 16,7), followed by that in the phase of flowering ($\bar{O}$ = 18,06), and the highest – in the phase of square formationa ($\bar{O}$ = 22,23).

CONCLUSIONS

1. The weed species Amaranthus retroflexus L., Solanum nigrum L. and Convolvulus arvensis L., irrespective of

their density, reduced the moisture in the soil layers 0-10 cm, 10-20 cm and 20-30 cm in the phases of flowering and maturity in cotton, and this fact was proved statistically.

2. In the phase of square formation no significant differences with respect to moisture were observed in the three soil layers. The only exception was the variant with the highest density of the weeds Convolvulus arvensis L. - 4 weeds/m^2, Amaranthus retroflexus L. and Solanum nigrum L. – 8 weeds/m^2, where this index decreased statistically ($\bar{O}$ = 20,6 in the layer 0-10 cm; $\bar{O}$ = 19,56 in the layer 10-20 cm; and $\bar{O}$ = 19,16 in the layer 20-30 cm).

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