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INITIAL RESEARCH ON THE INFLUENCE OF THE COLOUR OF THE PEA LEAVES ON THE INFESTATION BY THRIPS

WSTĘPNE BADANIA NAD WPŁYWEM BARWY LIŚCI GROCHU NA ZASIEDLENIE PRZEZ WCIORNASTKI

Abstract: Based on the spectrophotometer analysis and the statistical data processing it was found that the colour of the pea leaves significantly influences the infestation by thrips. The positive correlation was found between summary content of chlorophylls in the pea leaves, represented by the absorbance at $\lambda = 680$ nm and the average number of thrips. The greater content of the chlorophylls was noticed for the cultivars heavier infested by thrips ('Hazard', 'Walor', 'Jubilat' and 'Maraton') and the lower concentration of chlorophylls was found for the cultivars less infested by thrips.

Keywords: thrips, peas, chlorophylls level, leaf colour

The thrips (*Thysanoptera*) have negative influence on the cultivation of the pea. They feed on leaves, flower buds, flowers and pods causing atrophy, deformation and preventing nucleation. The pea plantations are threatened by the infestation of thrips during the whole vegetation period [1, 2].

Due to the tendencies to limit the use of pesticides, especially in the plantation intended for consumption, it is of vital importance to find and cultivate the pea cultivars resistant to or tolerating the feeding pests. The research of many authors suggests that the visual stimulus is the initial factors influencing the selection of plants by insects and that the plant tissue can also effect the infestation by thrips [3, 4]. This is related to the ability of insects for the reception of the light waves reflected from the surface of the leaves or coming through the leaves of wide range of wavelengths (from $\lambda = 260$ nm – ultraviolet to $\lambda = 720$ nm – red) [5]. Because of this, the antixenotic resistance of plants can vary depending on the differences in colour of the different fragments of

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plants, for example of leaves. Such differences were found, among other, in the resistance of the cabbage on *Pieris* sp., spinach and red garden beet on *Aphis fabae* [6–8]. Very few studies have been carried out with plants in order to identify the patterns of resistance against thrips. Up to now, the only trial on antixenotic resistance against onion thrips under field conditions as well as laboratory was carried out by Fail et al [9] and Stoner and Shelton [10]. The number of works about the influence of the colour on the behaviour of thrips during the plant selection and infestation is also very limited [11, 12].

Material and methods

In the research carried out at the Experimental Station in Mydlniki in 2008, 16 cultivars of eatable pea differencing in the purpose and the length of the maturation were used. These cultivars are listed in Table 1. All pea cultivars were sown on 31st March, on plots of 4 m × 16 m. To demonstrate the relations between the intensity of the green colour of the leaves in particular pea cultivars and the degree of infestation by thrips, the analysis of colour of leaves using analysis of leaf colour was performed on the basis of visible light absorption spectra of tissue samples obtained with a JASCO V-530 spectrophotometer. This allowed *in vivo* colour characteristics to be made on fresh leaves, on the basis of chlorophylls and carotenoids they contain [data not published]. The fragments of leaves were collected on 15th May. The degree of infestation of particular pea cultivars by thrips was estimated on the plants using the standard entomological sweep net. To collect one sample, 25 capturing movement with sweep net were made. Four samples were collected from each species. The samples were collected two times during the phase of main pea sprout forming. The obtained results were statistically analysed using Statistica 6.0.

Results and discussion

The degree of infestation of particular pea cultivars by thrips was varying. The total mean number of thrips collected on 16 pea cultivars during the period of main pea sprout forming was from 32 to 3.2 thrips per1 sample. The significantly higher number of thrips was collected on ‘Hazard’ cv., and then on ‘Walor’, ‘Pionier’, ‘Demon’, ‘Jubilat’ and ‘Maraton’ cultivars, while the lowest number was noticed on ‘Polar’, ‘Duet’ and ‘Cud Kelwedonu’ cultivars. The analysis of the mean number of thrips collected during individual analysis and the mean total number show significant differences between tested cultivars. The results from the first collection of thrips show significant statistical differences between the most infested cultivars ‘Hazard’ and ‘Pionier’ and the low infested cultivars ‘Polar’, ‘Baron’, ‘Cud Kelwedonu’ and ‘Muskat’. The comparison of mean numbers of thrips gathered in the second collection and the summary average indicate the significant differences between cultivars ‘Hazard’ and ‘Walor’, and the cultivars ‘Polar’ and ‘Duet’ (Table 1).

Table 1

Mean number of thrips collected from peas with sweep net

Cultivar	Analysis		Mean
	1st analysis	2nd analysis	
Baron F_1	1.3 a	7.7 ab	4.5 ab
Bohun F_1	4.0 abc	6.3 ab	5.2 ab
Cud Kelwedonu F_1	1.3 a	5.3 ab	3.3 ab
Demon F_1	4.7 abc	16.7 cd	10.7 ab
Domino F_1	3.2 abc	8.0 ab	6.2 ab
Duet F_1	3.0 abc	4.0 a	3.5 a
Hazard F_1	44.0 e	20.7 d	32.0 d
Hetman F_1	3.7 abc	6.3 ab	5.0 ab
Jubilat F_1	10.0 cd	10 ab	10.0 bc
Kaskada F_1	2.3 ab	5.7 ab	4.0 ab
Maraton F_1	5.7 abc	11.7 ab	8.7 ab
Muskat F_1	1.7 a	12.3 bc	7.0 ab
Pionier F_1	15.7 d	8.0 ab	11.8 abcd
Polar F_1	1.0 a	5.0 a	3.2 a
Set F_1	4.0 abc	6.3 ab	5.2 ab
WalorF_1	9.3 abc	20.3 d	14.8 c

Means in the columns marked with different letters are significantly different at $p \leq 0.05$.

Table 2

Absorption at λ = 680 nm reflecting the contents of chlorophylls read from absorption spectrum of pea leaves

Cultivar	Repetitions				A_{mean}	Relative error [%]
	A_1	A_2	A_3	A_4		
Baron F_1	0.73	1.20	1.20	1.00	1.03	21.6
Bohun F_1	1.00	1.04	1.25	1.40	1.17	16.0
Cud Kelwedon F_1	1.29	1.30	1.30	1.34	1.31	1.7
Demon F_1	1.42	1.54	1.60	1.25	1.45	10.6
Domino F_1	1.28	1.14	1.40	1.52	1.34	12.2
Duet F_1	1.10	1.10	1.37	1.23	1.20	10.7
Hazard F_1	1.31	1.40	1.43	1.42	1.39	3.9
Hetman F_1	1.30	1.30	1.38	1.40	1.35	3.9
Jubilat F_1	1.57	1.60	1.48	1.55	1.55	3.3
Kaskada F_1	1.40	1.00	1.58	1.23	1.30	19.0
Maraton F_1	1.40	1.37	1.36	1.25	1.35	4.9
Muskat F_1	1.26	1.55	1.36	1.42	1.40	8.7
Pionier F_1	1.30	1.28	1.30	1.16	1.26	5.3
Polar F_1	1.00	1.22	1.38	1.30	1.23	13.4
Set F_1	1.47	1.57	1.50	1.60	1.54	3.9
Walor F_1	1.90	1.72	1.60	1.51	1.68	10.0

To find one of the possible reasons for the different degree of infestation, the colours of leaves were compared. It was found in most cases, that the cultivars heavier infested by thrips have greater content of chlorophylls, while the cultivars less infested have the lower content of chlorophylls (Tables 1 and 2).

The examples of absorption spectrum of pea leaves for 'Polar' and 'Walor' cultivars are given in Fig. 1.

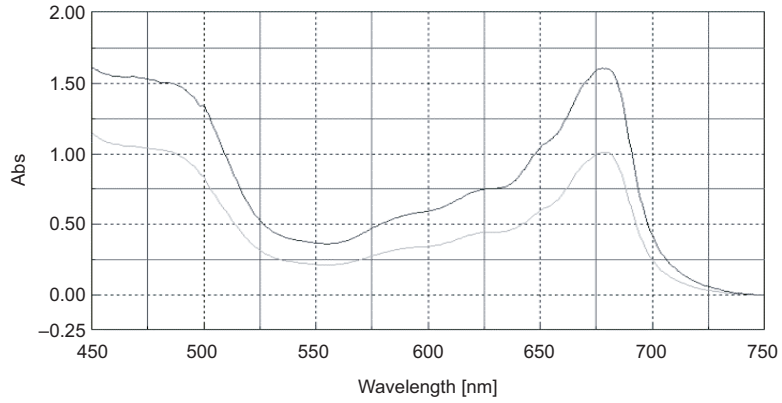

Fig. 1. The examples of absorption spectrums of pea leaf samples in the range of visible light from 450 to 750 nm; The blue line (higher) – 'Walor' cv., the green line (lower) – 'Pionier' cv.; The greater absorption at λ_{max} = 680 nm represents higher content of chlorophylls

The band in the spectrum with maximum at λ_{max} = 880 nm is only due to the presence of chlorophylls, and the rest of spectrum is also due to the presence of carotenoids in leaves. The higher absorption within this range represents the darker green due the greater content of chlorophylls or thickness of leaves. For 'Walor' cultivar, which was more infested, the greater absorption was noticed within nearly whole range of visible light, however the most significant difference was noticed for λ = 680 nm.

The positive Spaerman correlation between summary content of chlorophylls in the pea leaves, represented by the absorbance at λ = 680 nm, and the average number of thrips collected on the plants and the summary average was found (Table 3). At the same time, no better correlations between other wavelengths were found, especially at the wavelength of λ = 470 nm, which should show the potential influence of the carotenoids on the background of chlorophylls. Also no anthocyanin pigments were found on the pea leaves, which is in line with the other results presented in the literature. These results confirm and suggest that the different intensity of the green colour of leaves can be treated as one of the factors deciding about the attractiveness of pea plants for thrips.

The research on the antixenotic resistance of different cabbage cultivars against infestation by *Thrips tabaci* Fail et al [9] shows that the groups of resistant cultivars have greater reflectance intensity than the group of susceptible.

Table 3

Correlation of R Spaermana between absorption at λ = 680 nm reflecting the contents of chlorophylls read from absorption spectrum on pea leaves and the infestation by thrips

The examined parameters of infestation	$R_{Spearmana}$
Absorbance at 680 nm – mean number of thrips for 1st analysis	0.258006
Absorbance at 680 nm – mean number of collected thrips for 2nd analysis	0.603938
Absorbance at 680 nm – total mean number of thrips	0.417145

The selected correlations are significant at $p < 0.001$.

The influence of the intensity of green colour of leaves is also confirmed by the works of other authors. According to Myers [6] the female of *Pieris* sp. preferred the cabbage cultivars having more intensive green colour of leaves. The research by Luczak [13] indicates that the winged forms of black bean aphids preferred the cultivars of sugar beet with light-green leaves, having the lower contents of vegetable dyes, especially yellow and orange (flavones and carotenoids). The similar results were received in the case of spinach and the garden beet [7, 8]. Such relationships were also observed in the infestation of cauliflower by *Brevocoryne brassicae* [14].

Conclusions

Based on the spectrophotometric analysis and the statistical data processing it was found that the colour of the pea leaves significantly influences the infestation by thrips. The intensity of absorbance demonstrated by pea leaves in the range of red light with a maximum at λ = 680 nm has the positive effect on the infestation of pea by thrips. The most important factor deciding about the attractiveness was the intensity of the green color, which is the typical feature of the pea, and less significant were the minor differences in the leaf colors caused by the different contents of the carotenoids, chlorophyll *a* and chlorophyll *b*.

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WSTĘPNE BADANIA NAD WPŁYWEM BARWY LIŚCI GROCHU NA ZASIEDLENIE PRZEZ WCIORNASTKI

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Streszczenie: W wyniku przeprowadzonych analiz spektrofotometrycznych i opracowania statystycznego stwierdzono, że barwa liści grochu ma istotny wpływ na zasiedlenie ich przez wciornastki. Dla badanych odmian stwierdzono pozytywną korelację pomiędzy sumaryczną zawartością chlorofili w liściach grochu, oznaczoną poprzez pomiar absorbancji przy λ = 680 nm, a średnią liczebnością wciornastków. Odmiany silniej zasiedlane przez wciornastki (‘Hazard’, ‘Walor’, ‘Jubilat’ i ‘Maraton’) odznaczały się większą zawartością chlorofili, z kolei mniej licznie zasiedlane odmiany (‘Polar’ i ‘Duet’) należały do grupy odmian o mniejszej zawartości chlorofili.

Słowa kluczowe: wciornastki, groch, poziom chlorofili, barwa liści