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Pesticide-free Protection of White Cabbage against *Thrips tabaci* Lindeman

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In autumn 2002 field screening tests were carried out at the National Institute for Agricultural Quality Control in order to assess the susceptibility of 52 white cabbage varieties to *Thrips tabaci.* The evaluation based on the degree of damage occurring on the head leaves. In case of each variety, all the damaged leaves of 10 mature cabbage heads were marked with the appropriate value of the six-degree damage rating scale created for the procedure. The ratings for each leaf expressed the size of the damaged surface proportional to the surface of the whole leaf. Varietal resistance was represented by the sum of these values (proportional to the surface of the first head leaf) expressing the damage observed on the whole head. The number of damaged leaves was also counted. All varieties suffered smaller or greater damage. However, 'Bariton', 'Bently', 'Desmond', 'Avalon', 'Masada' and 'Transam' were the least damaged and described as resistant varieties, therefore recommended for late autumn cabbage production. The damage decreased from month to month from September till December.

Keywords: *Brassica oleracea* convar. *capitata* provar. *capitata,* white cabbage, *Thrips tabaci,* resistance.

In Hungary the onion thrips (*Thrips tabaci* Lind.) was first observed damaging white cabbage (*Brassica oleracea* L. convar. *capitata* [L.] Alef. var. alba [DC.]) outdoors in the early 1980s (Kristóf and Pénzes, 1984). Since then, it has become one of the main obstacles in the development of quality cabbage growing in Hungary as well as in several regions of the world. Thrips injury appears as bronze discoloration and rough texture on the head leaves and results in cabbage that does not meet fresh market standards (North and Shelton, 1986a). According to North and Shelton (1986b), all stages of thrips may be found in the mature head. This coincides with our own observations (Fail and Pénzes, 2002a). After head formation has started, onion thrips colonise the cabbage plant in mass from other hosts, including alfalfa, red clover (Shelton and North, 1986) and amongst many others all kinds of onion (Fail and Pénzes, 2002b).

The use of insecticides results in poor control of onion thrips on cabbage (Andaloro et al. 1983), and the release of predatory mites on cabbage fields does not give adequate control either (Hoy and Glenister, 1991). Based on extensive research, Shelton stated that the primary control for thrips damaging cabbage should be the selection of tolerant varieties (Shelton et al., 1998), although the timing of planting is also a possible mean of protection, as it can reduce the damage (Stoner and Shelton, 1988a). Field trials have been carried out in order to assess the resistance of several cabbage varieties against onion thrips. The screening method has been based on either the extent of the injury observed on leaves

(Pénzes and Szani, 1990, 1992a, 1992b; Pénzes et al., 1996, 1998, 2000), or on both the extent of the injury and the number of thrips collected (Shelton et al., 1983, 1988; Stoner and Shelton, 1988b). The effect of timed growing under our climatic conditions has not been illustrated by thorough observations.

In this presentation, we aimed to emphasize the significance of varietal resistance as a pesticide-free protection method.

Materials and Methods

Field screening tests were carried out at a station (Szarvas) of the National Institute for Agricultural Quality Control (NIAQC) in 2002. Greenhouse-grown plants of 52 varieties were transplanted outdoors from June till July. Plots were composed of 5 rows of 13 plants, spaced 0.5 by 0.4 or 0.6 by 0.6 or 0.7 by 0.5 m apart. Plots were replicated twice in a randomised complete block design with an alleyway of 3 m separating replicates. Standard herbicide and fertilization practices were employed. Plants were treated by pesticides against pests and diseases. Varieties matured at different times and each was screened during the period of its optimum maturity. One variety was sampled only once by evaluating the thrips injury observed only on the head leaves of 5 randomly chosen plants per replicates. For this purpose, a six-degree damage rating scale was elaborated based on the extent of the symptoms appearing on the leaves:

0 – No damage
1 – Few rough brown blisters, less than 10% of the leaf is covered
2 – Blisters covering not more than 33% of the leaf
3 – Blisters covering not more than 50% of the leaf
4 – Blisters covering not more than 75% of the leaf
5 – Blisters covering more than 75% of the leaf.

Leaves were evaluated and peeled off the head one after the other until three consecutive leaves showed no damage. The extent of damage (ratings of the scale) and the number of the leaf (the first one being the outer, the second being the one below it and so on) on which it was observed were noted. In order to exclude subjectivity the vast majority of the evaluation procedure was done by the same person. Varieties were code-named therefore unknown at the time of observation. The damage ratings were replaced by the arithmetical mean of scale terms (for example the rating "2" was replaced by "0.2166", the mean of 0.1 and 0.33). The new ratings for each leaf expressed the size of the damaged surface proportional to the surface of the whole leaf. Varietal resistance was represented by the sum of these values (proportional to the surface of the first head leaf) expressing the damage observed on the whole head ("1.0" means the surface of the whole 1st head leaf). The number of the damaged leaves in the head was also counted. Analysis of variance was performed on cumulated damage ratings and number of damaged leaves for separate groups of varieties screened roughly at the same time. Varieties of the same group were compared in pairs by Games–Howell tests.

Results

Sampling data were divided into four groups based on the date of the observation. Varieties assessed at the same time (with deviation no longer than two weeks during the harvest in autumn) were mounted into one group. The susceptibility of varieties was compared only within groups. The values in the column "Sum of damage" – expressing the susceptibility of varieties – were counted as the statistical average of the cumulated damage ratios counted for each observed head with 10 replicates for every variety. The higher values indicate susceptibility, whereas the lower ones resistance. Average number of damaged leaves was similarly counted. By this means two ranking lists were created within groups.

The greatest differences between varieties were found during September in the 1st group *(Table 1).* Varieties assessed in October and November suffered significantly smaller damage *(Tables 3* and *4).* There were inconsiderable differences between varieties in the 2nd group *(Table 2).*

Table 1

Rate of damage caused by onion thrips to cabbage varieties in the 1st group

Number of damaged leaves				Sum of damage ("1.0"=the surface of 1st head leaf)			
Variety	Date of assessment	Average[a]	Standard deviation	Variety	Date of assessment	Average[a]	Standard deviation
Consul	24 September	12.0 a	2.6	Green Gem	19 September	1.9 a	0.8
Green Gem	19 September	11.1 ab	3.1	Rinda	17 September	1.5 ab	1.0
Estron	17 September	7.5 abc	3.1	Consul	24 September	1.5 ab	0.9
Rinda	17 September	11.6 abcdef	6.5	Castello	24 September	0.8 bc	0.5
Combinor	17 September	6.0 abcdef	3.9	Combinor	17 September	0.7 bc	0.6
Marcello	17 September	5.0 bcdef	3.7	Estron	17 September	0.7 bc	0.6
Sutri	24 September	6.0 cd	2.4	Sutri	24 September	0.7 bc	0.8
Castello	24 September	5.7 cde	2.7	Morris	17 September	0.6 bc	0.6
Score	18 September	4.8 cdef	3.3	Fanion	24 September	0.6 bc	0.5
Morris	17 September	4.6 cdef	3.2	Marcello	17 September	0.5 c	0.5
Fanion	24 September	4.5 cdef	3.4	Score	18 September	0.4 c	0.5
Histona	18 September	4.2 cdef	2.6	Frontor	18 September	0.4 c	0.6
Satelite	18 September	3.4 cdef	2.8	Gloria	24 September	0.4 c	0.5
Gloria	24 September	3.0 cdef	2.4	Histona	18 September	0.3 c	0.1
Frontor	18 September	2.7 cdef	2.0	Fieldforce	18 September	0.3 c	0.6
Fieldforce	18 September	2.5 cdef	2.6	Satelite	18 September	0.2 c	0.3
Matsumo	18 September	2.3 def	1.8	Frontor	18 September	0.2 c	0.3
Frontor	18 September	1.7 ef	1.8	Matsumo	18 September	0.1 c	0.1
Pruktor	19 September	0.9 f	0.9	Pruktor	19 September	0.1 c	0.1
Riana	18 September	0.4 f	0.5	Riana	18 September	0.0 c	0.0

[a] Significance: values denoted by similar letters are not significantly different from each other at p=0.05 (ANOVA, Games–Howell test pairwise comparison).

Table 2

Rate of damage caused by onion thrips to varieties in the 2nd group

Number of damaged leaves				Sum of damage ("1.0"=the surface of 1st head leaf)			
Variety	Date of assessment	Average[a]	Standard deviation	Variety	Date of assessment	Average[a]	Standard deviation
Quisto	1 October	8.6 a	5.8	Quisto	1 October	1.2 a	1.2
Quisto	1 October	5.9 ab	3.9	Quisto	1 October	1.1 a	0.8
YR Atlas	10 October	5.5 ab	2.0	Ramada	1 October	0.9 a	0.9
Gideon	1 October	5.1 ab	3.5	Gideon	1 October	0.7 a	0.6
Sutri	1 October	4.9 ab	3.3	Sutri	1 October	0.6 a	0.6
Ramada	1 October	4.8 ab	2.7	Gloria	1 October	0.5 a	0.7
Gloria	1 October	3.8 ab	3.5	YR Atlas	10 October	0.5 a	0.3
Geronimo	1 October	3.5 b	2.2	Geronimo	1 October	0.4 a	0.5
Bronco	1 October	2.7 b	2.7	Bronco	1 October	0.2 a	0.3

[a] Significance: values denoted by similar letters are not significantly different from each other at p=0.05 (ANOVA, Games–Howell test pairwise comparison).

Table 3

Rate of damage caused by onion thrips to varieties in the 3rd group

Number of damaged leaves				Sum of damage ("1.0"=the surface of 1st head leaf)			
Variety	Date of assessment	Average[a]	Standard deviation	Variety	Date of assessment	Average[a]	Standard deviation
Hurricane	20 November	7.7 a	1.3	Erdeno	20 November	0.6 a	0.3
Erdeno	20 November	6.4 ab	1.4	Hurricane	20 November	0.8 ab	0.5
Quisto	31 October	6.2 abc	3.3	Coronet	20 November	0.2 ab	0.1
Junior	31 October	3.9 abcd	3.5	Quisto	31 October	0.7 abc	0.7
Coronet	20 November	3.8 bc	2.1	Ama-Daneza	20 November	0.3 abc	0.2
Agressor	20 November	3.4 bcd	3.1	Junior	31 October	0.2 abc	0.3
Leopard	31 October	3.3 c	1.6	Agressor	20 November	0.2 abc	0.2
Fieldrocket	20 November	3.1 cd	1.5	Fieldrocket	20 November	0.2 abc	0.1
Ama-Daneza	20 November	3.1 cd	1.6	Leopard	31 October	0.2 bc	0.2
Discover	20 November	3.0 cd	1.7	Discover	20 November	0.2 bc	0.1
Transam	20 November	1.0 d	0.7	Transam	20 November	0.1 c	0.0

[a] Significance: values denoted by similar letters are not significantly different from each other at p=0.05 (ANOVA, Games–Howell test pairwise comparison).

Discussion

Although no varieties were found absolutely resistant to thrips injury, there were significant differences in the degree of susceptibility. Although the greatest damage and differences between varieties appeared in late summer (Fail and Pénzes, 2002a), this study showed that damaging by thrips continues during autumn. The sum of damage decreased

Table 4

Rate of damage caused by onion thrips to varieties in the 4th group

Number of damaged leaves				Sum of damage ("1.0"=the surface of 1st head leaf)			
Variety	Date of assessment	Average[a]	Standard deviation	Variety	Date of assessment	Average[a]	Standard deviation
Hinova	5 December	11.0 a	2.9	Hinova	5 December	0.9 a	0.5
Atria	5 December	9.7 ab	4.5	Atria	5 December	0.8 a	0.4
Scanvi	5 December	7.9 abc	3.0	Scanvi	5 December	0.4 ab	0.2
Brigadier	5 December	6.2 bcd	2.8	Brigadier	5 December	0.5 abc	0.3
Burton	5 December	5.9 bcd	2.4	Burton	5 December	0.6 abcd	0.6
Upton	5 December	5.9 bcd	3.1	Upton	5 December	0.4 abcd	0.3
Ancoma	5 December	4.2 cde	4.7	Ancoma	5 December	0.3 abcd	0.3
Dialog	5 December	2.2 de	2.3	Dialog	5 December	0.1 bcd	0.2
Strukton	5 December	2.1 de	1.9	Strukton	5 December	0.1 cd	0.1
Masada	5 December	1.5 e	1.4	Masada	5 December	0.1 d	0.1
Avalon	5 December	1.4 e	1.8	Avalon	5 December	0.1 d	0.1
Desmond	5 December	1.2 e	2.2	Desmond	5 December	0.1 d	0.1
Bently	5 December	0.8 e	1.0	Bently	5 December	0.0 d	0.1
Bariton	5 December	0.6 e	1.0	Bariton	5 December	0.0 d	0.0

[a] Significance: values denoted by similar letters are not significantly different from each other at p=0.05 (ANOVA, Games–Howell test pairwise comparison).

from month to month from September till December. We think that during this period the role of the fall in temperature is the significant factor in the tendency of decreasing damage.

The two ranking lists are very similar but not the same except in the fourth group in December *(Table 4).* In some cases varieties are significantly equal in "Sum of damage" but differ in "number of damaged leaves". Between these varieties those are considered more susceptible, that in the head more damaged leaves have. The practical reason behind this is that growers peel off the outer obviously damaged leaves at harvest and with more injured leaves there will be greater weight-loss. For instance in the first group 'Sutri' and 'Consul' suffered the same damage but 'Consul' had twice as many injured leaves *(Table 1).* In the third group 'Hurricane' and 'Coronet' had the same damage but 'Hurricane' had more damaged layers *(Table 3).* In the fourth group 'Hinova' and 'Brigadier' were damaged similarly, but 'Hinova' was more susceptible *(Table 4).*

In the first group 'Green Gem', 'Consul', 'Rinda' and 'Combinor' suffered the highest damage. 'Frontor', 'Matsumo', 'Pruktor' and 'Riana' were the less susceptible ones *(Table 1).* In the second group 'Quisto' was the most susceptible variety and 'Bronco' was the least susceptible. However, in this group the differences between varieties appeared to be the smallest *(Table 2).* In the third group 'Hurrican', 'Erdeno', 'Quisto' and 'Coronet' suffered the highest injury and 'Fieldrocket', 'Discover' and 'Transam' were more resistant *(Table 3).* In the fourth group 'Hinova', 'Atria' and 'Scanvi' were the most susceptible and 'Desmond', 'Bently' and 'Bariton' showed the smallest damage *(Table 4).*

Based on the results the varieties 'Bariton', 'Bently', 'Desmond', 'Avalon', 'Masada' and 'Transam' are recommended for late autumn cabbage production.

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