Resistance of cabbage (*Brassica oleracea capitata* group) populations to *Mamestra brassicae* (L.)

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Introduction

Cabbage (*Brassica oleracea capitata* group) crops are severely damaged by different insect pests. Larvae of lepidopterous pests feed on foliage, creating large holes in leaves. Cabbage plants can tolerate some feeding damage before head formation. However, as larvae grow, they move to the center of the plant, boring into the cabbage head and resulting in head deformation, which reduce product marketability (Shelton et al., 1982). Feeding damage also increases the plants' susceptibility to diseases. The use of resistant cultivars could benefit growers by reducing insecticide use and decreasing the rate at which insects develop resistance to insecticides. Insect resistance in *Brassica* crops is well documented. Most studies have focused on cabbage resistance to three major lepidopterous pests: *Pieris rapae* (L.), *Plutella xylostella* (L.), and *Trichoplusia ni* (Hübner) (Dickson and Eckenrode, 1980; Hoy and Shelton, 1987) and few studies have been conducted to find germplasm resistant to other important pest such as *Mamestra brassicae* (L.) (Picoaga et al., 2003). However, until now, breeding for resistance to lepidopterous insects has yielded very little success. The objective of this work was to evaluate the performance of cabbage populations to leaf damage by lepidopterous pests in northwestern Spain.

Material and Methods

Sixteen populations of cabbages and five commercial hybrids were evaluated in NW Spain under natural and artificial infestation with larvae of *M. brassicae* in 2006 and 2007, respectively. Populations were evaluated in a randomized complete block design with two replications. Experimental plots consisted of three rows with 10 plants per row. Rows were spaced 0.8 m apart and plants within rows 0.5 m apart. In 2006, data were taken three months after transplanting on 10 plants randomly chosen per plot. Under artificial infestation, six plants from each plot were randomly selected and artificially infested with five larvae per plant two months after transplanting. The larvae were reared at our laboratory and placed in the back of the upper leaves of the plant. Data were taken one month after infestation. Data were recorded as general appearance, by using a visual damage rating from 1= wholly damaged to 9= no injury, number of larvae of *M. brassicae* per plant, and plant leaf area removed, by using a visual rating scale from 0%= no injury to 100%= wholly damaged. Individual and combined analyses of variance were performed for all traits for each environment. Replications were considered as random factors whereas populations and environments were considered as fixed effects. Comparisons of means were made using Fisher's protected least significant difference (LSD) at P=0.05. All analyses were made with the SAS statistical package (SAS Institute, 2000).

Results and Discussion

There were significant differences among populations for each of the resistance parameters measured (*P*

≤ 0.05) (data not shown). Under natural infestation, commercial varieties were more resistant than cabbages landraces and showed highest values for appearance ratings, lowest percentage of leaf area removed, and had few larvae (Table 1).

Damage evaluated under natural infestation includes damage caused by all lepidopterous pests since all species may occur in a single plant, causing similar feeding injury. Larvae can be easily identified but it is difficult to associate damage with species when crops are attacked by a complex of pests that causes similar injury (Dickson and Eckenrode 1980). Although resistance to one species of lepidoptera cannot be translated to resistance to another, approximately 70% of total larvae found in 2006 corresponded to *M. brassicae* larvae. This species was also the most abundant in *Brassica* crops in NW Spain over the last seven years (unpublished data). For this reason, populations were infested in 2007 with *M. brassicae* larvae. Considering the same resistance attributes that in 2006 under natural infestation, the commercial varieties had the lowest feeding injury. They had the best general appearance rating (above than 7 value) and the lowest plant leaf area damaged (below 11%). Among local populations, MBG-BRS0074 and MBG-BRS0057 were the most damaged at two years. They showed lowest values for general appearance and the largest percentage of plant leaf area damaged. MBG-BRS0074 showed the highest percentage of leaf area damaged and the highest number of *M. brassicae* larvae per plant under natural infestation and the lowest value for general appearance under artificial infestation. Larvae per plant may be used as indicator of the pest incidence but is not useful to evaluate genotypes (Picoaga et al., 2003). MBG-BRS0411 had fewer larvae than other populations under natural infestation but showed a high percentage of damaged leaf area and a bad general appearance under artificial infestation. Hence, this accession could be also susceptible to these pests. MBG-BRS0409 performed differently at each year. Under natural infestation this population was quite susceptible to pest attack whereas under artificial infestation showed a lowest percentage of leaf area removed and had few larvae. Natural field populations can be used to screen resistance but artificial infestation is more efficient.

In previous studies, agronomic and nutritional characterizations of the same cabbage populations were made and their morphological attributes (Padilla et al., 2007) and foliar glucosinolate composition was noted (Cartea et al., 2008). A relationship between plant earliness and resistance could be present although further research is required on this issue. Dickson and Eckenrode (1980) found that resistance in cabbage and cauliflower is maintained irrespective of plant age and that plants with moderate tolerance only express it at maturity. The relation between glucosinolate content and level of resistance is unclear and other plant phytochemicals are presumably involved on the resistance of this pest. Further research is required to search anatomic or antibiotic factors involved in this resistance.

References

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Table 1. Means for damage traits for the some local cabbage populations and three commercial varieties evaluated in 2006 and 2007 in northwestern Spain.

	Year 2006 (natural infestation)			Year 2007 (artificial infestation)		
Populations (MBG-)	General[1] appearance	Leaf area[2] removed	*Mamestra* larvae/plant	General[1] appearance	Leaf area[2] removed	*Mamestra* larvae/plant
BRS0452	6.6 c	32.8 bc	2.4 ab	4.7 gh	37.9 a	2.5 b-d
BRS0536	6.2 c-e	29.0 b-d	1.6 b-d	5.5 e-h	28.2a-d	5.6 a
BRS0449	6.5 cd	28.0 b-d	0.8 d-g	5.8 d-g	28.2 a-d	2.0 b-d
BRS0057	5.4 f	37.1 ab	1.4 b-f	5.4 e-h	26.2 a-d	5.6 a
BRS0074	6.0 c-f	45.3 a	3.0 a	4.5 h	34.8 ab	1.0 b-d
BRS0400	5.4 f	31.9 bc	0.6 d-g	6.5 b-e	21.1 c-e	1.5 b-d
BRS0409	4.1 g	37.3 ab	1.9 a-c	6.0 c-f	16.2 d-g	1.0 b-d
BRS0411	5.7 d-f	28.7 b-d	0.1 g	5.3 f-h	30.7 a-c	1.6 b-d
Red cabbage	8.0 a	3.0 g	0.3 e-g	7.8 a	6.0 fg	0.3 cd
White cabbage	7.5 ab	11.3 fg	0.2 fg	7.8 a	4.7 g	0.2 cd
Savoy cabbage	7.7 a	10.9 fg	0.2 fg	7.2 a-c	10.8 e-g	0.1 d

[1] Visual rating from 1= wholly damaged to 9= without damage
[2] Visual rating from 0%= no injury to 100%= wholly damaged

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