

# RESPONSE OF TRITICALE TO THE HESSIAN FLY (DIPTERA: CECIDOMYIIDAE)

J. W. Johnson, G. D. Buntin, J. E. Foster,  
J. J. Roberts, and P. L. Raymer<sup>1</sup>

Departments of Agronomy and Entomology  
Georgia Station<sup>2</sup>

Experiment, GA 30212

(Accepted for publication October 7, 1986)

## ABSTRACT

Hessian fly infestation on triticale (*X tritico-secale* Wittmack) has not been previously reported. Severe infestations on wheat in Georgia prompted the evaluation of triticale germplasm in the greenhouse to known biotypes of Hessian fly and in the field to natural populations. Susceptible triticale plants showed the same characteristics as susceptible wheat plants. 'Beagle 82', 'Wytch', and 'Marta', as well as several experimental lines, were highly resistant to biotype D Hessian fly. 'M2A-Beagle' and 'Great Northern' were the only entries highly resistant to biotype E, the predominant biotype population in the Southeast. The total number of flies per 30-cm row averaged 58 and 283 at Experiment and Plains, respectively. Morrison had the lowest percentage of infested tillers. 'Jenkins' and 'Council' were the most severely infested cultivars. Crosses have been made to determine the genetics of Hessian fly resistance identified in these studies.

Key Words: Hessian fly, *Mayetiola destructor*, triticale, host plant resistance.

J. Entomol. Sci. 22(1): 51-54 (January 1987)

## INTRODUCTION

Increased populations of Hessian fly, *Mayetiola destructor* (Say), have been reported by Johnson et al. (1985) on wheat, *Triticum aestivum* L., in Georgia. Hessian fly infestations on wheat have been reported in the Southeast periodically for many years (Hatchett 1969; Morrill and Nelson 1976). Cartwright (1922) recorded that Hessian fly infestation was primarily on wheat and barley. Rye had only a slight infestation and oats were not infested. This report is the first in the literature on Hessian fly infestation on triticale (*X tritico-secale* Wittmack). Because of the Hessian fly's widespread occurrence and severity, it threatens the development of triticale in the Southeast as a successful grain crop.

Triticale is a new, synthetic, small grain crop produced by crossing wheat and rye. It has excellent feed quality, and is high in both protein and lysine. Cultivars of triticale are currently available for production by farmers in the Southeast. The Beagle 82 cultivar was developed and released jointly by Georgia and Florida Agricultural Experiment Stations in 1984 (Morey and Barnett 1984). Morrison was released in 1984 by Alabama A & M University (Sapra 1985). The success of

<sup>1</sup> Associate Professor, assistant professor, Research Entomologist (USDA/ARS), Purdue Univ., Research Geneticist (USDA/ARS), and assistant professor, Departments of Agronomy, and Entomology, Georgia Station, respectively.

<sup>2</sup> Contribution from Dep. of Agronomy, Univ. of Georgia, Georgia Station, GA 30223. Supported by State or Hatch funds allocated to the Georgia Agric. Exp. Stations.

triticale in the Southeast depends partly on its resistance to insects and diseases. Results on the evaluation of triticale germplasm to Hessian fly infestations are reported herein.

## MATERIALS AND METHODS

### *Greenhouse*

Twenty cultivars and/or experimental lines of triticale were exposed in the greenhouse to biotypes D and E of the Hessian fly. The biotypes used were bulk populations originally purified by Sosa and Gallun (1973). Seeds of each entry were planted in  $54 \times 36 \times 8$  cm wooden flats filled with a greenhouse mixture. Each flat contained ten 36-cm rows with 15 seeds per row of each entry. A completely randomized design was used with two replicates. Checks were centrally located in each flat. When the seedlings were approximately 5 cm tall, the flats were infested with biotype D or E of the Hessian fly. The experiment was repeated again with biotype E. Adult flies were permitted to emerge from infested wheat debris and to oviposit over a 2 to 3-day period under a nylon tent covering the flats (Cartwright and LaHue 1944). Plants were rated 21 days after infestations as susceptible or resistant. Biotype D was discovered in Indiana fields in 1968 and has virulence on either the  $H_3$  or the  $H_6$  genes (Hatchett and Gallun 1968). Biotype E was discovered in Georgia in 1969 and is the predominate biotype in the Southeast (Hatchett 1969). Four checks, 'Seneca', 'Knox 62', 'Monon', and 'Abe' were used.

### *Field Studies*

Differences between triticale cultivars were first noted in the field during November, 1984. In 1985, eight cultivars were evaluated in the field at two locations (Experiment and Plains, GA). All entries were planted in October in  $1.3 \times 3$  meter plots.

Fall infestation levels of the Hessian fly were determined in January 1986 by harvesting a 30-cm row segment from each plot. Tiller number, number of infested tillers, and number of larvae and puparia were recorded for each sample. Percent infested tillers and number of flies per 30 cm of row were calculated. Experimental design was a randomized complete block with 4 and 3 replications at Plains and Experiment, respectively. Data were analyzed with an analysis of variance and Duncan's multiple range test.

## RESULTS AND DISCUSSION

### *Greenhouse*

Susceptible triticale plants showed the same characteristics as susceptible wheat plants (Cartwright et al. 1959). Plants were stunted and dark blue-green in appearance with the third leaf flattened. Live larvae were present at the fourth basal node. Resistant plants expressed normal growth without stunting or the presence of live larvae. Resistance to biotype D was exhibited in several cultivars and experimental lines (Table 1). 'Beagle 82', 'Wytch', and 'Marta' were the only three cultivars that expressed any resistance to biotype D. 'Morrison' appeared to be segregating for resistance based upon the mixed reaction. Several experimental lines however, showed potential as sources of resistance. Three 'X-15671' sister

Table 1. Reactions of triticale cultivars and/or experimental lines to biotype D and E of Hessian fly.

| Entry          | Biotype  |         |
|----------------|----------|---------|
|                | D*       | E       |
| Beagle 82      | 85 (13)  | 0 (28)  |
| Calm           | 0 (13)   | 3 (32)  |
| Council        | 0 ( 9)   | 11 (28) |
| Grace          | 0 (14)   | 63 (25) |
| Great Northern | 8 (12)   | 89 (26) |
| Jenkins        | 0 (15)   | 10 (21) |
| Marta          | 75 ( 4)  | 0 (24)  |
| Morrison       | 40 (10)  | 54 (26) |
| Peace          | 0 (11)   | 0 (25)  |
| Siskiyou       | 0 ( 8)   | 0 (33)  |
| Wytch          | 100 (10) | 56 (23) |
| ARK 2094       | 80 (10)  | 0 ( 5)  |
| ARK 2306       | 71 ( 7)  | 24 (34) |
| IA-KOALA/CAL   | 50 ( 2)  | 1 (20)  |
| M2A-Beagle     | 78 ( 9)  | 96 (28) |
| OK 77842       | 0 ( 4)   | 0 (28)  |
| TX 80A529      | 26 ( 7)  | 31 (37) |
| X-15671-FP18   | 100 ( 8) | 41 (27) |
| X-15671-611    | 90 (10)  | 40 (25) |
| X-15671-FP7    | 100 (10) | 46 (22) |

\* Mean percentage of noninfested plants from two replicates with total number of plants in parentheses.

lines, 'M2A-Beagle', 'Arkansas 2094', and 'Arkansas 2306' expressed a high level of resistance.

Biotype E expressed a high level of virulence to certain cultivars and experimental lines (Table 1). M2A-Beagle and 'Great Northern' showed high levels of resistance. Morrison, Wytch, and 'Grace' gave a segregating reaction to biotype E. Beagle 82, the most popular cultivar in Georgia, was completely susceptible (100%) to biotype E, which is the predominate biotype in the Southeast. These results suggest that a germplasm base is available for a breeding program on the development of resistance in triticale to biotypes D and E.

### Field

Visual estimates of Hessian fly damage in the fall of 1984 indicated that major differences in resistance existed in cultivars of triticale. Infestation ranged from 13 to 100%. Hessian fly infestations in 1985-86 were more severe at the Plains location than at Experiment (Table 2). The total number of flies per 30-cm row and the number of flies per plant averaged 58 and 3 for Experiment and averaged 283 and 12 for Plains, respectively.

The percentages of infested tillers, however, were comparable at both locations, with percentages ranging from 11 to 46% at Experiment and 11 to 62% at Plains. Morrison had the lowest percentage of infested tillers, at both locations, and was the only entry that consistently expressed resistance. These field results for

Table 2. Reactions of seven triticale cultivars to Hessian fly infestations at Experiment and Plains, GA. 1986.

| Cultivars   | Experiment          |                         | Plains             |                         |
|-------------|---------------------|-------------------------|--------------------|-------------------------|
|             | % infested tillers* | Flies per 30 cm of row† | % infested tillers | Flies per 30 cm of row† |
| Jenkins     | 46 a                | 64 ab                   | 62 a               | 285 ab                  |
| Council     | 42 ab               | 96 a                    | 51 ab              | 234 ab                  |
| AM 4105     | 30 abc              | 52 ab                   | 47 b               | 436 a                   |
| Trical III  | 26 abc              | 66 ab                   | 41 b               | 228 ab                  |
| Beagle 82   | 24 abc              | 28 b                    | 40 b               | 313 ab                  |
| Florida 201 | 16 bc               | 9 b                     | 42 b               | 356 a                   |
| Morrison    | 11 c                | 20 b                    | 11 c               | 131 b                   |

\* Means within a column followed by the same letter are not significantly different according to Duncan's Multiple Range Test.

† Total number of larvae and puparia.

Morrison showed a mixed reaction to Hessian fly with infested tillers of 11% and with 131 flies per 30 cm of row.

Jenkins and Council were the most severely infested cultivars at both locations. Therefore, both cultivars were classified as very susceptible in the field. AM 4105, Beagle 82, Florida 201, and Trical III showed intermediate resistance levels at Experiment, but under the higher infestations at Plains, these lines appeared susceptible to the Hessian fly. From visual observations, Trical III showed the ability to tiller profusely and recovered from some of the fly damage.

Additional sources of resistance to Hessian fly in triticale must be identified and incorporated into new cultivars. The mode of gene action and the number of genes involved for resistance to Hessian fly in triticale are being investigated.

#### LITERATURE CITED

- Cartwright, W. B. 1922. Host plant selection by Hessian fly (*Phytophaga destructor* Say). J. Econ. Entomol. 15: 360-63.
- Cartwright, W. B., and D. W. LaHue. 1944. Testing wheats in the greenhouse for Hessian fly resistance. J. Econ. Entomol. 37: 385-87.
- Cartwright, W. B., R. L. Gallun, and L. C. Compton. 1959. Response of resistant and susceptible wheats to Hessian fly attack.
- Hatchett, J. H. 1969. Race E, sixth race of Hessian fly, *Mayetiola destructor*, discovered in Georgia wheat fields. Ann. Entomol. Soc. Am. 62: 677-78.
- Hatchett, J. H., and R. L. Gallun. 1968. Frequency of Hessian fly, *Mayetiola destructor*, races in field populations. Ann. Entomol. Soc. Am. 61: 1446-49.
- Johnson, J. W., J. J. Roberts, W. A. Gardner, and J. E. Foster. 1985. Occurrence and importance of Hessian fly in Georgia. J. Georgia Entomol. Soc. 9: 538-42.
- Morey, D. D., and R. D. Barnett. 1984. Registration of Beagle 82 Triticale. Crop Sci. 24: 826.
- Morrill, W. L., and L. R. Nelson. 1976. Hessian fly control with carbofuran. J. Econ. Entomol. 69: 123-24.
- Sapra, V. T. 1985. Registration of Morrison Triticale. Crop Sci. 25: 887.
- Sosa, Omelio, Jr., and R. L. Gallun. 1973. Purification of races of B and C of Hessian fly by genetic manipulation. Ann. Entomol. Soc. Am. 66: 1065-70.