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Impact of Cereal Aphids Feeding on Yield of Spring Wheat in Central Saudi Arabia

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ABSTRACT. A two-season field experiment was conducted in Gassim Region to evaluate yield losses in wheat, cv. Yecorah Rojo, due to feeding of cereal aphids on foliage and ears. Caged plots were artificially colonized with 0, 10, 20 and 40 aphids/stem. Caged ears were colonized with the same aphid densities at three growth stages. Losses in grain weight and grain number at 10 aphids/stem infestation level amounted up to 27.0% and 20.2% in 1987/88 season, and 12.7% and 9.3% in 1988/89 season, respectively.

When aphids fed on developing ears, the 10 aphids/ear level resulted in grain weight and grain number reductions amounting up to 35.5% and 37.0%, 13.0% and 13.4% and 9.0% and 4.7% when infestations were started at head emergence, head flowering or head maturity, respectively. Infestations starting at head emergence were more damaging than those starting later. It is recommended that treatments should be started at levels below 10 aphids per stem or ear (at head emergence).

Introduction

Cereal aphids, especially *Schizaphs graminum* (Rondani), *Rhopalosiphum padi* (Fitch.) and *Diuraphis noxia* (Madv.) infest wheat and barley throughout the Central Region of the Kingdom of Saudi Arabia (El Hag and El Meleigi 1991). Numerous reports have been published on plant injury and yield reductions caused by aphid feeding on wheat and barley such as decreases in the number of grains per ear, thousand grain weight, number of ears, and other yield measurements, (Burton *et al.* 1985, McPherson *et al.* 1986, Kieckhefer and Kantack 1986).

Crop damage and threshold levels vary greatly according to time of the year, geographical location, aphid feeding site (Wratten 1974, Liu *et al.* 1986) or crop phenology (Kieckhefer and Kantack 1986). Using different techniques to maintain various infestation levels, economic thresholds have been developed in some situations. Stern (1967) recommended treating greenbugs when their population is expected to exceed 25-30 individuals/wheat tiller; no growth stage was indicated. Kieckhefer and Kantack (1986) reported significant yield reductions in barley at artificial aphid densities of 25-30 aphids/stem, at boot stage. An economic threshold of 16 aphids/tiller was recommended by BaAngood and Stewart (1980), while Burton *et al.* (1985) suggested fewer than 10 greenbugs per plant for fall wheat, and fewer than 20 greenbugs per plant for spring wheat. For aphids feeding on wheat ears, George (1975) derived an economic threshold of 5 or more aphids/head at flowering. BaAngood and Stewart (1980) recommended treating at aphid levels of 10-18/ear at flowering and 8-16 aphids/ear at the milky-ripe stage. Based on an acceptable 5% yield loss, Liu *et al.* (1986) arrived at an economic threshold of 4-5 aphids/ear up to and during anthesis.

In Central Saudi Arabia cereal aphids reach damaging levels only after the booting stage; when most of the aphid feeding is on the developing ears and maturing leaves (El Hag and El Meleigi 1991). Because the economic injury levels and the economic thresholds are unclear, the present study was aimed at measuring yield losses incurred due to feeding by cereal aphids at a range of densities on wheat foliage and on ears under field conditions. The results should be useful in the determination of economic injury levels and economic thresholds, to improve the accuracy of cereal aphid control decisions in this region.

Material and Methods

Two field experiments were conducted during winter seasons of 1987/88 and 1988/89, at the College of Agriculture Experimental Farm at Meleida, on the wheat cultivar Yecora Rojo (obtained from Genetics International of California, USA).

Experiment 1

This experiment was conducted to evaluate yield losses caused by feeding of different densities of aphids (*S. graminum* and *R. padi*) on foliage during and after the booting growth stage (Zadoks *et al.* 1974).

Sixteen experimental plots, each comprising five rows, one-meter each, were established randomly in a 15 × 20 m wheat stand. A buffer zone of at least one metre was left between plots to reduce problems associated with insecticide drift (Hendrickson and Day 1986). The experimental unit was 0.3 m of row in each plot selected randomly and replicated four times in a completely randomized design. Before the units were infested with aphids the stand was thinned to 5 stems/0.3 m row (Burton *et al.* 1985). Plots were allocated for aphid levels of 0, 10, 20 and 40 aphids/stem. Each of the twelve experimental units was infested with 5 adults or nymphs per stem, from laboratory reared colonies. The plants were at the boot stage (Zadoks *et al.* 1974) when infested. If aphids did not establish themselves, plots were reinfested a few

days later. The plants in each experimental unit were enclosed with a muslin-covered wooden cage (35 × 35 × 50 cm) to prevent aphid contamination of control plots, and to restrict aphid movement into and out of the treated plots. At the time of experimentation, natural aphid infestations in the surrounding fields were 0.94 and 0.18 aphids/stem in 1987/88 and 1988/89, respectively.

In infested units, aphids were allowed to increase until the infestation reached the designated levels and the time taken was recorded. Infestations were terminated at this point by applying pirimicarb sprays (0.5 gm a.i./l.).

Visible plant damage was recorded using the method of Burton *et al.* (1985) based on a 1-9 scale (1 = no aphid damage, 9 = all plants dead or dying). Wheat ears were hand-harvested, threshed, grains weighed and number of grains per ear was determined.

Experiment 2

In this experiment the procedure developed by Liu *et al.* (1986) was followed with slight modifications. The aim was to investigate the above effect on yield components by caging aphids on individual wheat heads.

Heads of wheat (cv. Yecorah Rojo) were covered with perforated 15 × 25 cm plastic bags just after ear emergence. The ears selected were of comparable size. Caged ears were inoculated with females from a laboratory reared colony at the rate of 0, 10, 20 and 40 aphids/ear at ear emergence, flowering and at milky-ripe stage (except in 1988/89). Aphids were left in the cages for five days after the soft dough stage when they were killed with pirimicarb sprays, as in previous test.

Treatments were arranged in a completely randomized design. Each individual wheat ear served as a replication, 10 replications per aphid inoculation level were used for each ear development stage. Aphids on ears were kept constant for each inoculation level by counting and adjusting them twice weekly. At maturity, individual ears were hand-harvested, threshed and weights were determined.

Results and Discussion

Experiment I

The introduction of 5 females and/or nymphs per stem resulted in peak levels of 10, 20 and 40 aphids per stem after 12, 15 and 21 days in the 1987/88 and after 8, 13, and 16 days in the 1988/89 trials, respectively. The visible plant damage according to the 1-9 scale was 1, 2-3, 4-6 and 7-8 in 1987/88, while it was 1-2, 3-4, 4-6 and 7-8 in 1988/89, for aphid levels of 0, 10, 20 and 40 aphids/stem, respectively. Most of the plants at the 40 aphids/stem level showed severe yellowing, necrosis or drying up, while those at the 10 aphids/stem showed only slight localized yellowing or browning.

The grain weight, grain number and losses incurred at each aphid infestation level in the two seasons are given in Tables 1-3. Statistical analysis revealed that significant differences exist ($P = 0.05$) between yields in the control, treatments and all levels of

aphid infestation in season 1987/88, (*i.e.*, in grain weight and grain number), Table 1. No significant differences were observed between yields obtained at aphid levels 10 or 20 per stem, but did exist between these two levels and the 40 aphids/stem level of infestation, Table 1. In season 1988/89, the analysis disclosed significant differences ($P = 0.05$) between yields obtained in the control treatments and the two higher levels of infestation. No significant differences were evident between the control and the 10 aphids/stem level, however, a 12.7% yield reduction was observed at this level compared to the control, Table 2. The same pattern was observed when looking at the grain number, which showed a 9.3% reduction when stems were infested with 10 aphids/stem levels, compared to the control. Significant differences did exist between the control and the 20 and 40 aphid/stem levels, both in grain weight and grain number as well as between the 10 and 20 aphid/stem levels, in grain number. In fact, the non-significant differences between 20 aphids/stem and 40 aphids/stem indicate that when the infestation reached 20 aphids/stem the damage has already happened to the crop.

TABLE 1. Average grain weight and grain number per stem of artificially aphid-infested caged wheat at varying levels of infestation; Gassim 1987/88, 1988/89.

No. of aphids / stem	*Means ± S.D			
	Grain weight (gm / ear)		Grain no. / ear	
	1987 / 1988	1988 / 1989	1987 / 1988	1988 / 1989
0	1.89 ± 0.3a	1.10 ± 0.2a	40.9 ± 7.2a	26.8 ± 1.9a
10	1.38 ± 0.45b	0.96 ± 0.1ba	32.7 ± 8.3b	24.4 ± 2.3ba
20	1.39 ± 0.3b	0.75 ± 0.2bc	31.1 ± 6.7b	22.3 ± 1.5bc
40	1.16 ± 0.3c	0.63 ± 0.2c	27.1 ± 6.7c	18.3 ± 4.4c

*Means (in vertical columns) followed by the same letter are not significantly different.

The calculated percentages of yield reduction due to aphid feeding at the three aphid/stem levels of infestation were given in Table 2. Yield losses in season 1987/88 were substantial even at the lowest tested level, *i.e.*, 10 aphids/stem, both in grain weight and grain number, being 27.0 and 20.2%, respectively. Losses are even greater in grain weight in 1988/89 than in the previous season at the 20 and 40 aphids/stem levels.

The yields per head were noticeably lower in 1988/89 season relative to those obtained in the previous season. This was reflected on total yield when estimated in ton/ha., Table 3. This trend in the second year's crop was attributed to environmental stresses such as abrupt temperature fluctuations, Table 4. Similar to the previous season, high losses were incurred at aphid/stem levels exceeding 10 individuals/stem when infestations started at boot stage. In both seasons the estimated losses at the lowest aphid infestation level ranged between 0.28-1.02 ton/ha, Table 3. An economic appraisal of the infestation indicates that an average farmer holding 25 ha, loses between 14-51 thousand SR/season of his profits (assuming a price of 2 SR/kg of wheat). This, obviously, is a substantial reduction in net profits that a farmer would

TABLE 2. Mean percent yield reductions when aphids were introduced at 10, 20, and 40 aphids per stem (1987/88 and 1988/89).

Aphid level per stem	% Yield reduction / ear			
	In grain weight		In grain number	
	1987/88	1988/89	1987/88	1988/89
10	27.0	12.7	20.2	9.3
20	26.5	31.8	24.1	16.9
40	38.6	42.7	33.9	31.8
S.D. (±)	6.8	15.2	7.1	11.4

TABLE 3. Grain losses in t/ha incurred due to various levels of aphids infestation per wheat stem (1987/88 and 1988).

No. of aphids per stem	Grain weight* t/ha		Losses t/ha	
	1987/88	1988/89	1987/88	1988/89
Zero	3.8 ± 0.6	2.2 ± 0.3	–	–
10	2.8 ± 0.9	1.9 ± 0.2	1.02	0.28
20	2.8 ± 0.6	1.5 ± 0.4	1.0	0.70
40	2.3 ± 0.6	1.3 ± 0.5	1.5	0.94

*Based on estimates of an average farm having 2 million ear/ha, (El-Meleigi *et al.* 1990).

$$\frac{\text{Grain weight/ear (gm)} \times \text{2 million}}{1000 \times 100} = \text{t / ha}$$

TABLE 4. Minimum, maximum and mean* temperatures and relative humidity for months Oct. 88–June 1989, Buraydah, Gassim**.

Month	Temperature (°C)			Relative humidity (%)		
	Min.	Max.	Mean	Min.	Max.	Mean
Oct. 1988	14	38	26.8	18	66	36.6
Nov. 1988	3	33	17.9	29	81	46.3
Dec. 1988	– 1	28	14.3	14	100	62.6
Jan. 1989	– 4	24	8.9	14	92	53.8
Feb. 1989	– 5	29	11.2	20	88	50.5
March 1989	6	33	19.1	22	95	49.8
April 1989	11	37	22.7	25	91	42.2
May 1989	18	43	30.1	14	46	28.1
June 1989	14	44	31.2	17	44	25.7

*Means calculated using $\frac{\bar{X}\ \text{Min.} + \bar{X}\ \text{Min.}}{2}$ for each month.

**Source: Gassim airport meteorological data, 1988/1989.

try to avoid by selecting lower economic thresholds in light of costs of control measures.

An acceptable loss level of 5% has been referred to by some researchers, (Liu *et al.* 1986), but in many cases only aphid/stem levels were mentioned. Kieckhefer and Kantack (1986) suggested that 25-30 aphids/stem (artificial infestation) at boot stage, will significantly reduce barley yields. Stern (1967) recommended treatment when populations were expected to exceed 25-30 aphids per wheat tiller. However, both former reports did not specify the crop growth stage or the amount of losses. An economic threshold of 16 aphids/tiller was recommended by BaAngood and Stewart (1980). Burton *et al.* (1985) suggested less than 10 greenbugs per plant for fall wheat, and less than 20 greenbugs/plant for spring wheat. Our result is in agreement with that of Burton *et al.* (1985) for fall wheat, although the aphids multiplication rate in this warm environment is relatively faster.

Experiment II

The results of this experiment are shown in Tables 5-9, for the two seasons 1987/88 and 1988/89. The 87/88 data indicated that yields were significantly reduced ($P = 0.05$) when ears were infested with 20 aphids each or more at the stages of emergence or flowering, and at maturity at 40 aphids/ear, (Tables 5 and 6). Reductions in grain weight were as high as 31 and 37% (Table 7) when ears were each infested with 20 aphids at emergence or flowering, respectively. When infestations at 40 aphids/ear, were started at either ear emergence or flowering, yields were severely reduced, approaching 50%, but at maturity they were not as great. Reductions in yield at the 10 aphids/ear level were 13% and 9.1% when infestations were started at head flowering and head maturity, respectively, a loss unlikely to be tolerated by the producer.

In Table 8, the loss in ton/ha was calculated based on an estimated 2 million heads/ha/average wheat field in the region (El Meleigi *et al.* 1990). Grain production at zero

TABLE 5. Average grain weight (gm/ear) obtained at various levels of aphid infestations per wheat ear, for two seasons, Gassim 1987/1988, 1988/1989.

Level of aphid infestation	$X \mp$ S.D of grain weight / ear (gm) at 3 stages of ear development*			Overall average
	At emergence	At flowering	At maturity	
0	87/88 1.9 + 0.4 a	1.5 + 0.4 a	1.8 + 0.2 a	1.7 a
	88/89 1.1 + 0.2 a	1.1 + 0.4 a	–	1.1 a
10	87/88 1.8 + 0.3 a	1.3 + 0.3 a	1.6 + 0.3 a	1.6 a
	88/89 0.7 + 0.4 b	1.1 + 0.3 a	–	0.9 b
20	87/88 1.3 + 0.5 b	0.97 + 0.4 b	1.5 + 0.3 a	1.2 b
	88/89 0.5 + 0.1 b	1.0 + 0.2 a	–	0.8 c
40	87/88 0.9 + 0.3 b	0.8 + 0.2 b	0.4 + 0.5 b	1.0 b
	88/89 0.6 + 0.3 b		–	0.5 a

*Means (in vertical columns) followed by the same letter are not significantly different.

TABLE 6. Average grain number/ear of artificially aphid-infested wheat ears at varying pest densities at three stages of ear development, Gassim 1987/88 and 1988/89.

Level of aphid infestation / ear at	$\bar{X} \pm$ S.D* of grain no. at 3 stages of ear development			Overall average
	Emergence	Flowering	Maturity	
0	87/88 41.9 ± 9.3 a	35.1 ± 10.9 a	33.8 ± 7.2 a	37.0 a
	88/89 31.1 ± 5.0 a	31.6 ± 5.17 a	–	31.6 a
10	87/88 39.8 ± 6.2 a	30.4 ± 3.8 a	32.2 ± 7.6 a	34.1 b
	88/89 19.6 ± 6.3 a	31.4 ± 5.7 a	–	25.5 b
20	87/88 28.3 ± 9.5 b	25.7 ± 6.7 b	29.4 ± 5.0 a	28.8 b
	88/89 16.6 ± 1.7 b	31.6 ± 4.6 a	–	24.8 b
40	87/88 27.0 ± 6.5 b	28.4 ± 7.6 ac	30.9 ± 12.1 a	27.7 b
	88/89 18.7 ± 6.5 b	18.7 ± 6.5 b	–	18.7 c

*Means followed by the same letter are not significantly different (vertical columns).

TABLE 7. Mean percent yield reductions due to various levels of aphid infestations per wheat ear for two seasons, Gassim, 1987/1988, 1988/1989.

Aphid level per ear	% Yield reduction at											
	Ear emergence				Ear flowering				Ear maturity			
	Grain weight		Grain no.		Grain weight		Grain no.		Grain weight		Grain no.	
	87/88	88/89	87/88	88/89	87/88	88/89	87/88	88/89	87/88	88/89	87/88	88/89
10	2.7	35.5	5.0	37.0	13.0	4.5	13.4	0.6	9.1	–	4.7	–
20	30.8	56.3	32.5	46.6	37.0	8.0	26.8	0.0	14.0	–	13.1	–
40	49.7	49.1	35.6	39.9	49.4	57.5	19.0	40.8	19.4	–	8.6	–
S.D (±)	23.6	10.6	16.8	4.9	18.5	29.6	6.7	23.7	5.2	–	4.2	–

aphids/ear were 3.7, 3.1 and 3.5 ton/ha at ear emergence, flowering and maturity, respectively (Table 8). Greater losses are incurred when head infestations start at early crop stages and with increasing aphid/stem levels.

Grain number was also reduced due to aphid infestations. Significant differences in grain number/ear ($P = 0.05$) were observed between the control and the 20 and 40 aphids/ear, at ear emergence and flowering stages (Table 6). However, no differences were obtained at any of the aphid levels tested at the head maturity stage.

The results obtained in season 88/89, generally, indicate that yields are always significantly reduced at all aphid levels when infestations take place at ear emergence stage. However, the yield differences between aphid levels were not significant. At 10 aphids/ear at emergence, the grain weight and grain number obtained were 35.5 and 37% less than the control, respectively (Table 7) thus amounting to an estimated loss of 0.8 ton/ha (Table 8). At the 20 and 40 aphids/ear levels the grain weight reduc-

TABLE 8. Mean grain losses in t/ha, incurred due to various levels of aphid infestations per wheat ear, for two seasons, Gassim, 1987/88, 1988/89.

Aphid level per ear	*Grain weight (t/ha) + S.E						Losses (t/ha)					
	EE		EF		EM		EE		EF		EM	
	87/88	88/89	87/88	88/89	87/88	88/89	87/88	88/89	87/88	88/89	87/88	88/89
0	3.7 ± 0.8[a]	2.2 ± 0.5	3.1 ± 0.8[a]	2.3 ± 0.8	3.5 ± 0.4[a]	-	-	-	-	-	-	-
10	3.6 ± 0.6[a]	1.4 ± 0.7	2.7 ± 0.6[a]	2.2 ± 0.6	3.2 ± 0.6[a]	-	0.1	0.8	0.4	0.1	0.3	-
20	2.6 ± 1.0[b]	1.0 ± 0.2	1.9 ± 0.8[b]	2.1 ± 0.4	3.0 ± 0.6[a]	-	1.1	1.2	1.2	0.2	0.5	-
40	1.9 ± 0.6[b]	1.0 ± 0.5	1.6 ± 0.4[b]	1.0 ± 0.2	1.8 ± 1.0[a]	-	1.8	1.2	1.5	1.3	1.7	-

*Based on estimates of an average form supporting 2 million ears/ha (El Meleigi *et al.* 1990).

$$\frac{\text{Grain weight/ear (Gm)} \times 2 \text{ million}}{1000 \times 1000} = \text{t/ha}$$

EE = ear emergence, EF = ear flowering, EM = ear maturity.

tions were 56.4 and 49.1%, amounting to estimated losses of 1.2 and 1.2 ton/ha, respectively (Tables 7 and 8). Grain weight and grain number were both significantly lower (at the 10 and 20 aphids/ear levels) when infestations started at ear emergence than at flowering (Table 9), indicating that early infestations are more damaging to yields than those starting later. Losses consistently increased with increasing aphid/ear infestations, the greatest being at 40 aphids/ear (*i.e.*, 1.3 ton/ha) at flowering (Table 8).

TABLE 9. Grain weight and grain no./ear of wheat plants artificially infested with varying aphid densities at two stages of ear development, Gassim 1988/89.

Stage of ear development	*Mean ± S.D of grain weight (gm) or grain no./ear at aphid densities/ear							
	Zero		10		20		40	
	Weight	No.	Weight	No.	Weight	No	Weight	No.
At emergence	1.10 ± 0.24a	31.10 ± 5.0 a	0.71 ± 0.37a	19.60 ± 6.31a	0.48 ± 0.09a	16.60 ± 1.71a	0.56 ± 0.25b	18.7 ± 6.53a
At flowering	1.13 ± 0.42a	31.60 ± 5.17a	1.11 ± 0.28b	31.40 ± 5.68b	1.04 ± 0.22b	31.60 ± 4.50b	0.48 ± 0.11b	18.70 ± 6.45a

*Means in vertical columns followed by the same letter are not significantly different.

Yields were generally lower in season 88/89 than in the previous one, being 2.2 and 2.3 ton/ha for the controls at ear emergence and flowering, respectively, compared to 3.7 and 3.1 ton/ha in the previous season, respectively. However, the yield reductions in the two seasons were more or less similar for the two higher aphid/ear levels at ear emergence. These were 1.2 and 1.2 ton/ha for 88/89, and 1.1 and 1.8 ton/ha for the previous season, at 20 and 40 aphids/ear, respectively. At head emergence yield reductions at the 10 aphids/ear level were higher in season 88/89 than in the previous

one. However, the fact remains that even 10 aphids/ear at the emergence stage may produce an untolerable loss that may amount upto 35.5% of the total yields. Ten aphids/ear infestations starting at the total flowering stage may produce from 4.5-13% yield losses as found in season 88/89 and 87/88, respectively.

The results of the experiment agree with those of BaAngood and Stewart (1980) who recommended treatment at aphid levels of 10-18 per ear at flowering. They also do not contradict those of Liu *et al.* (1986) who arrived at an economic threshold of 4-5 aphids/ear upto and during flowering stage based on an acceptable 5% yield loss. In this study 10 aphids/ear at flowering produced between 4.5-13% yield reduction, thus suggesting an economic threshold below 10 aphids/ear. The findings that infestations starting at head emergence are more damaging to yields than those starting later, provide grounds for recommending treatments at levels below 10 aphids/ear at this crop development stage. This aphid/stem level of infestation at head emergence has resulted in yield reduction between 2.7-35.5% in seasons 87/88 and 88/89, respectively (Table 7). This wide range of variation between the two seasons could be due, mainly, to environmental seasons. The results also agree with those of George (1975) who derived an economic threshold of 5 or more aphids per ear at flowering.

As a conclusion, we can state that an economic damage amounting upto 13% can result if aphid infestation levels at head flowering stage reached 10 aphids/ear. However, if infestations start at head emergence stage this level may produce upto 35% yield losses. It is important here to reiterate the fact that economic thresholds have dynamic values that fluctuate continuously under the influence of crop values, costs of available control procedures and human preferences.

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تأثير الإصابة بحشرات المَنّ على إنتاجية القمح في أواسط المملكة العربية السعودية

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جامعة الملك سعود ، فرع القصيم ، بريدة ، المملكة العربية السعودية

المستخلص . أجريت تجربة حقلية في موسمين (١٩٨٨/٨٧م و ١٩٨٩/٨٨م) لتقييم الخسائر في إنتاجية القمح - صنف يوكرا روجو الناتجة عن تغذية حشرات المن على أوراق النبات أو على السنابل . أصيبت نباتات القمح المزروعة داخل أقفاص صناعيًا بعدد : صفر ، ١٠ ، ٢٠ و ٤٠ حشرة/نبات ، كما استخدمت نفس الكثافة / سنبلة لإصابة السنابل داخل أكياس بلاستيكية مخرمة ، في ثلاث مراحل من نموها . بلغت الخسائر في وزن الحبوب وعددها عند مستوى الإصابة ١٠ حشرات مَن / نبات ٢٧,٠٪ و ٢٠,٢٪ في الموسم الأول و ١٢,٧٪ و ٩,٣٪ في الموسم الثاني ، على التوالي .

عند تغذية الحشرات على السنابل النامية نتج - عند مستوى الإصابة ١٠ حشرات/سنبلة - انخفاض في وزن الحبوب وعددها/سنبلة بمقدار ٣٥,٥٪ و ٣٧,٠٪ ، ١٣,٠٪ و ١٣,٤٪ ، ٩,٠٪ و ٤,٧٪ على التوالي ، عندما بدأت الإصابة عند طرد السنابل ، عند الإزهار وعند نضج الحبوب ، على التوالي . لوحظ أن الإصابة التي تبدأ في مرحلة طرد السنابل تكون أكثر تأثيرًا على الإنتاجية عن تلك التي تبدأ متأخرة . نوصي ببدأ عمليات المكافحة قبل بلوغ أعداد المن ١٠ حشرات/نبات أو سنبلة (عند طرد السنابل) .