Table 1.—Effect[a] of various populations of *N. raphanus* on sorghum at different growth stages.

Portion of plant caged	Ca. no. bugs/plant	Seeds/head		% seeds germinating	Plant damage rating[b]
		Wt (g)	No.		
Entire plant at anthesis	4000	0.1 a	5 a		3.8 c
	2000	.2 a	94 a		2.6 b
	None	14.6 b	716 b		1.4 a
Head at anthesis	1000	2.0 a	57 a	1 a	
	None	28.8 c	998 c	53 b	
Head at dough stage	1000	9.3 ab	83 a	6 a	
	None	36.5 c	1364 d	48 b	

[a] Values not followed by the same letter are significantly different at $P = 0.05$.
[b] Damage rating based on 0 for no leaf injury to 5 for death of plant.

so we could measure damage. Table 1 gives the portion of the plant caged, the stage of plant development at the time of caging, the approximate number of bugs per cage, and the damage criteria. Each treatment with the bugs had a corresponding control (no bugs) in each of the 5 replicates.

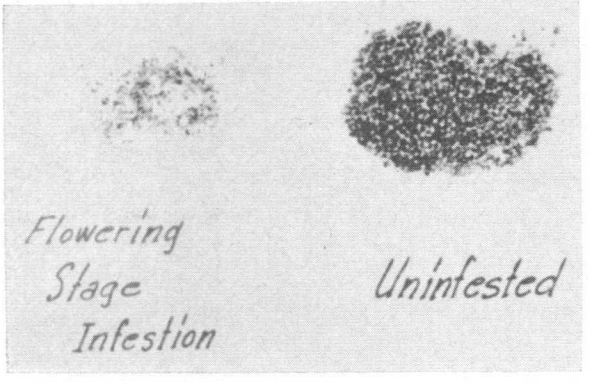

FIG. 1.—Damage to sorghum caused by *N. raphanus* infestation.

The test procedure caused some undesirable complications. The cages, especially those placed over entire plants, retained heat which resulted in poor seed development although the mortality of the bugs was low. Also, the sorghum midge, *Contarinia sorghicola* (Coquillet), laid eggs in florets touching the cloth over the ventilation holes and thus caused blasting of some seeds. Nevertheless, the results of treatments with and without *N. raphanus* showed that the bugs had a large effect on the weight and number of seeds (Fig. 1). For example, the percentage of germination of seeds in the controls, though it was not good, was much better than that of the corresponding treatment with bugs. Also, the bugs caused almost as much damage to seeds when the infestation started in the early dough stage (about 2 weeks after pollination) as when it started on heads at the beginning of anthesis. Damage ratings for entire plants were recorded only when the entire plant was caged, but they indicated that the bugs caused severe leaf injury or even death of the plants in addition to damage to developing heads.

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Life Cycle of the Convergent Lady Beetle[1] in Relation to Temperature[2]

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The convergent lady beetle, *Hippodamia convergens* Guérin-Méneville, a widely distributed species, is an important insect predator in Arizona alfalfa and cotton fields. The duration of the stages in California was determined by Clausen (1915) and in Florida by Miller and Thompson (1927). Nielson and Currie (1960) studied the biology of the species in Arizona when it was fed a diet of spotted alfalfa aphids, *Therioaphis maculata* (Buckton). However, none of these studies included information concerning development at different temperatures.

METHODS AND MATERIALS.—The convergent lady beetle larvae used in our tests were collected from Arizona alfalfa fields, placed in individual 50×12-mm petri dishes, and fed eggs of the Angoumois grain moth, *Sitotroga cerealella* (Oliver), while they were held at different constant temperatures. Duration of the pupal stage was determined by making daily observations of the larvae in the dishes. After eclosion, pairs of adults were placed in 100×15-mm petri dishes with either pea aphids, *Acyrthosiphon pisum* (Harris), or cotton aphids, *Aphis gossypii* Glover, and the dishes were examined daily for eggs. The eggs were counted, placed in separate petri dishes, held at the same constant temperature as the parents, and observed for hatching at 12-hr intervals. Also, individual 1st-instars were placed in 50×12-mm petri dishes with aphids, and the duration of the larval, prepupal, and pupal stages was determined by daily observation.

RESULTS AND DISCUSSION.—Table 1 shows the duration of developmental stages of the convergent lady beetle at

[1] Coleoptera: Coccinellidae.
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Table 1.—Time (days) required for development of the egg, larval, prepupal, and pupal stages of the convergent lady beetle at several constant temperatures.

Temp °C	Egg stage		Larval stage		Prepupal stage		Pupal stage	
	No.	Duration (days, $\bar{x} \pm$ SD)	No.	Duration (days, $\bar{x} \pm$ SD)	No.	Duration (days, $\bar{x} \pm$ SD)	No.	Duration (days, $\bar{x} \pm$ SD)
15.0							63	11.9±1.1
20.0	363	4.5±0.3	36	17.2±2.6	35	1.7±0.7	39	6.6±0.5
20.0							19	6.3± .4
22.8	402	3.8± .3	27	15.1±1.5	28	1.4± .5	35	5.4± .5
22.8							14	5.6± .7
25.0	510	3.0± .2	31	15.2±2.8	23	1.3± .5	29	5.0± .0
25.0							16	4.3± .7
28.9	630	2.4± .2	34	11.2±1.5	32	1.0± .0	39	3.6± .5
28.9							32	3.4± .7
30.0	969	1.8± .2	26	8.9±1.6	23	1.0± .0	50	3.0± .0
30.0							36	2.9± .5
33.9	848	1.9± .2	16	8.7±1.8	15	1.0± .0	25	3.0± .2
33.9							23	2.6± .5
37.2	25	2.0± .0	8	7.4±1.7			36	2.7± .4

Table 2.—Regression equations for the rate of development of stages of the covergent lady beetle in relation to temperature.

Stage	No. observed	Range of temp (°C)	Regression equation[a]	r^2
Egg	6	20–33.9	$-0.2921+0.0253X$	0.89
Larval	7	20–37.2	$-.0422+.0047X$	.96
Prepupal	4	20–28.9	$-.3299+.0454X$	.98
Pupal	14	15–37.2	$-.1378+.0145X$	.96

[a] Regression equation $\hat{Y} = a+bX$, where $\hat{Y}$ is the reciprocal of the number of days and X is the temperature in °C.

various constant temperatures. The regression equations calculated for each of the series (Table 2) produced high r^2 values, indicative of a uniform relationship between temperature and the rate of development of all stages.

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A Device for Injecting Grandlure into Cigarette Filters[1]

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In the past 2 years, large numbers of grandlure pellets were prepared at the Boll Weevil Research Laboratory, State College, Miss., for traps used in surveying and studying the boll weevil, *Anthonomus grandis* Boheman (Hardee et al. 1972; McKibben et al., unpublished data). Originally, pellets were prepared by manually pipetting 0.5 ml of grandlure solution onto cigarette filters. The procedure was slow, only ca. 500/hr could be completed, and considerable variation existed among doses dispensed by technicians.

Moody et al. (1972) constructed a device in which a solenoid-driven syringe was used to dispense the solution: filters were put into stems of funnels placed around the periphery of a turntable. At a certain point in the rotation, each funnel contacted a microswitch that actuated the solenoid which delivered the liquid into the stem of the funnel by depressing the syringe plunger through a lever. The grandlure was then absorbed by the filter.

I subsequently constructed a device that is somewhat faster and is easier to assemble (Figs. 1, 2, 3). The same

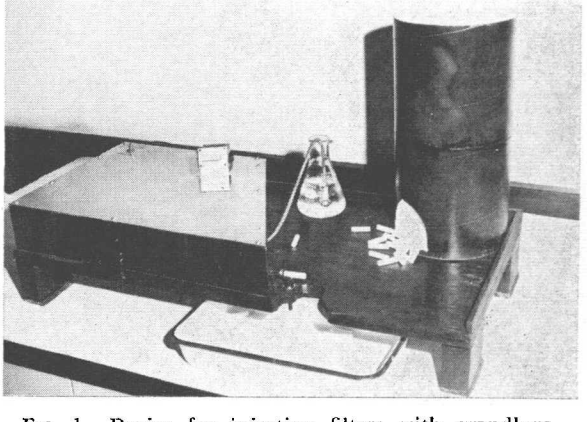

FIG. 1.—Device for injecting filters with grandlure.

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