

INSTAR DISTRIBUTIONS, NATURAL POPULATIONS, AND BIOLOGY OF THE BEAN LEAF ROLLER^{1, 2}

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ABSTRACT

Field populations of the bean leaf roller, *Urbanus proteus* (Linn.) on snap beans, were highest during October in central Florida. Larvae from approximately 4% of the eggs reached the fifth instar in field populations. Mortality of eggs and the first 2 larval instars was greater than for later instar larvae which survived quite well in the field. Egg hatch and larval development required 17 days at 85° F and took nearly twice as long at 75° F.

The bean leaf roller, *Urbanus proteus* (Linn.), is present on Florida snap beans each fall and may cause considerable damage (Quaintance 1898 and Watson and Tissot 1942). Seasonal history and development of the bean leaf roller must be defined in order to base control recommendations on population levels. Larval numbers which cause economic damage are presented elsewhere (Greene 1971). In this paper the population composition in respect to each immature life stage is reported along with immature development time.

METHODS

Populations were studied in the field near Sanford, Florida, on snap bean plants. Beans were planted during September of each year with 'Harvester' variety used during 1966 and 1967, and 'Early Harvester' during 1968 and 1969. These varieties produce relatively large plants with large leaves and have a 45 to 50 day growth period.

Bean leaf roller larvae present on 100 plants were counted twice a week when possible. The same 100 plants were checked each time and were marked with stakes numbered from 1 to 50, the plant on each side of the stake being sampled. Plants were located in a bean field at least 2 rows from the margins, although a marginal difference has not been noted. Specimens were not removed from the plants, and when a larva or egg fell from the plant during the counting process it was put back onto the plant. Numbers of each instar, distinguished by head size (Greene 1970), were recorded separately.

Adults were periodically observed by counting those flying in bean fields or visiting flowers of Florida beggarweed, *Desmodium tortuosum* DC., a larval host. Adults were placed in 6×6×6 ft cages with fresh bean plants each fall for oviposition information. Counts of eggs laid and adults surviving were made each day. Adult survival during cool nights

¹*Urbanus proteus* (Linn.) (Hesperiidae: Lepidoptera).

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of October and November was checked by releasing laboratory reared adults into 6×6×6 ft screen cages over bean plants.

Egg and larval development times were determined in constant temperature chambers. Eggs laid within a 2 hour period were held on bean leaves along with damp filter paper in a closed plastic dish 3/4 inch deep by 4 inches diam. Fresh leaves were put into the dishes every 2 days or as often as necessary.

RESULTS AND DISCUSSION

Counts of naturally occurring populations of bean leaf rollers on snap beans are shown in Fig. 1-4. The population levels for the four years relate to the number of butterflies observed. They were much more abundant during 1966 and 1969 than during 1967 and 1968.

OBSERVATIONS OF ADULTS

Field observations of adults indicate small populations each summer until September. During 1967, 1968 and 1969 less than one adult was observed per week on flowers in Seminole County, Florida, from 1 January until 1 July. Butterflies increased during July and August of 1968 and 1969. By 1 September, butterflies were present on flowers of *Lantana camara* Ling. and one was seen for every 10 min. of observation. In late September adults were very common at *Lantana* thickets. Large numbers of butterflies were observed on *Lantana* flowers during cool (65° F or lower) mornings and as the sun warmed the air to 70° F the butterflies began to fly. Snap bean fields were inhabited by numerous adults during October and butterflies were particularly abundant when the bean plants were flowering. Adult numbers decreased during November and December as temperatures declined and adult and larval food became less abundant. Adults were observed until temperatures went below 50° F during late October in 1966 and during December in 1967, 1968 and 1969.

It has been hypothesized that the butterflies in central Florida were migrants from the Southeastern United States migrating south each fall, as do many butterflies, and concentrating on the limited acreage of snap beans. However, the butterflies observed after heavy rains were fresh appearing as evidenced by their bright color and the presence of both tails suggesting that butterflies were local emergents (caged butterflies appeared badly beaten after rains). From observations of butterfly condition and abundance after adverse weather conditions, it appears that local larval populations produced most of the adults seen.

Adult survival was investigated during cool and rainy conditions by placing laboratory reared adults in 6 × 6 × 6 ft field cages. During warm days and the absence of rain, butterflies survived approximately 7 days. There was little survival in the cages after 2 nights of temperatures below 50° F or an inch of blowing rain.

Butterflies emerging in the laboratory produced viable eggs when placed outside in screen cages containing blooming bean plants. Feeding adults on sugar, honey, or molasses in several combinations and concentrations did not result in egg production. Newly emerged adults were force fed by uncoiling their proboscis with a needle and placing them into

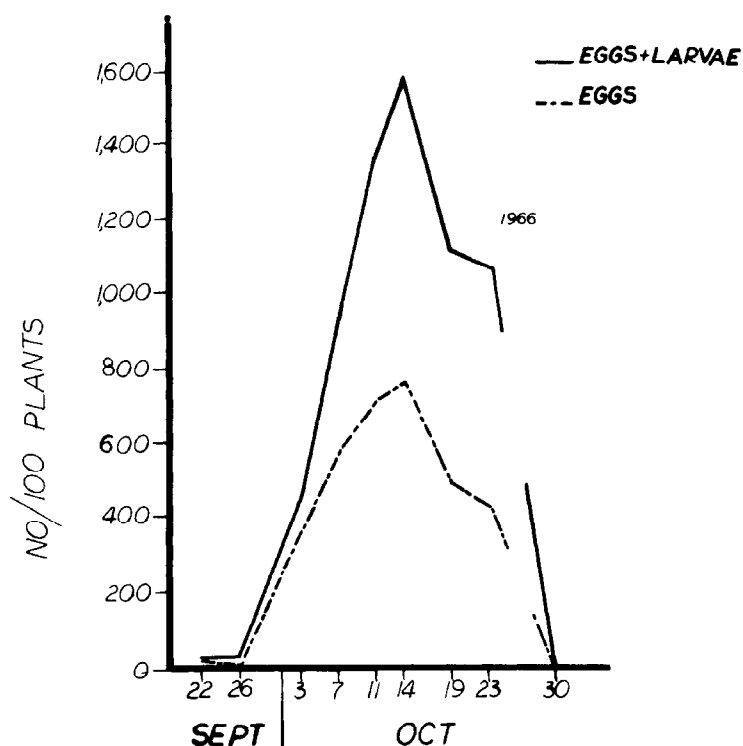


Fig. 1—Number of eggs and larvae of the bean leaf roller counted on 100 snap bean plants during the fall of 1966 at Sanford, Florida.

the sugar water. These caged adults were observed to feed again after release compared to untreated butterflies which were not observed to feed. Trials with several combinations of room size, temperature, artificial light, and greenhouse sizes did not result in oviposition on bean plants when fresh bean blooms were absent.

LARVAE AND EGGS ON FIELD PLANTS

Larval and egg counts shown in Fig. 1-4 are a reflection of the adult populations, growth condition of the host plants, and weather conditions. The 1966 field counts (Fig. 1) were of plants adjacent to flowering *Lantana*. The peak larval and egg counts occurred when bean plants began to flower in mid-October. In late October, cool nights below 50° F, and bean picking drastically reduced bean leaf roller populations. Prepupae were observed lying on the ground out of their prepupal chambers following a cool night. The plant maturity probably had the greatest effect on population reduction, even though butterflies were less abundant after the beans were picked.

The 1967 population (Fig. 2) was the lowest of the 4 years in conjunction with few adults being observed in the field. By November the population dropped in both egg and larval numbers after the host plants began to set beans and night temperatures fell below 50° F. These plants were

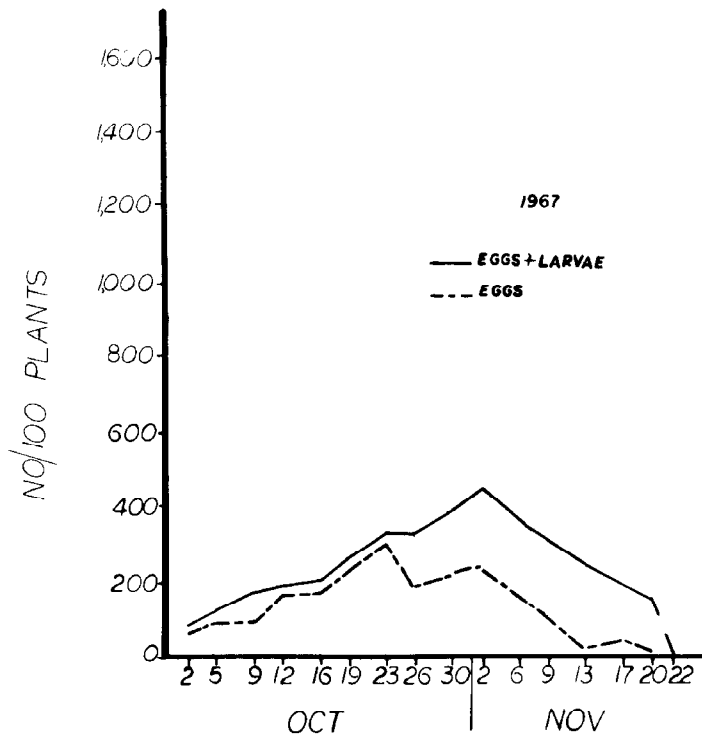


Fig. 2—Number of eggs and larvae of the bean leaf roller counted on 100 snap bean plants during the fall of 1967 at Sanford, Florida.

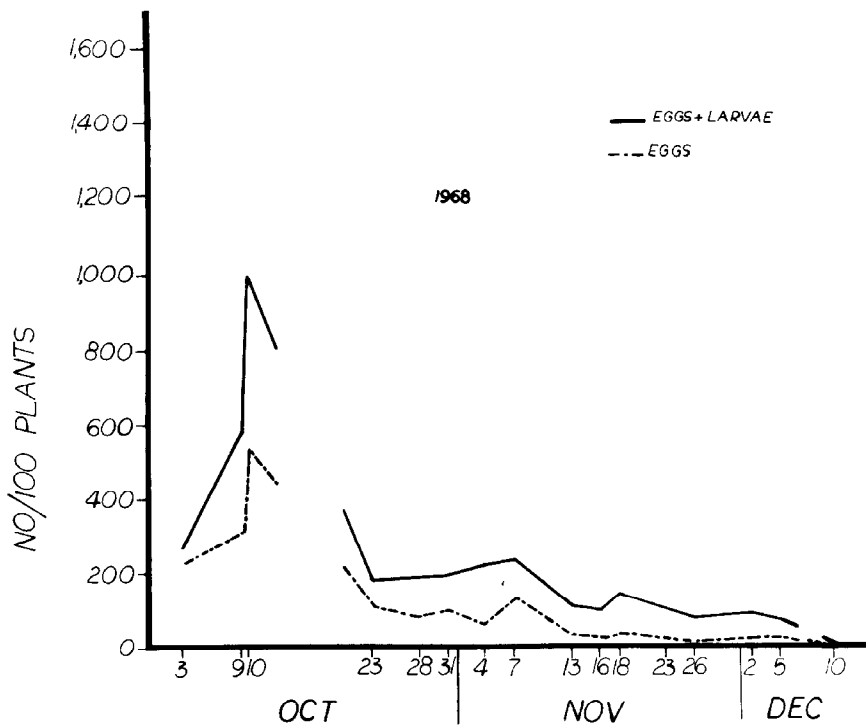


Fig. 3—Number of eggs and larvae of the bean leaf roller counted on 100 snap bean plants during the fall of 1968 at Sanford, Florida.

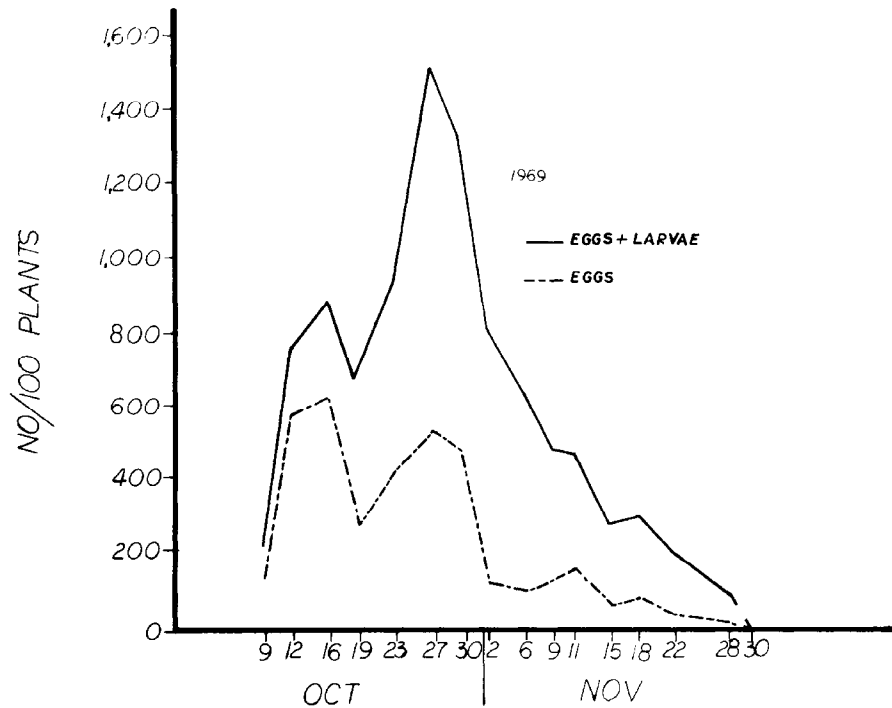


Fig. 4—Number of eggs and larvae of the bean leaf roller counted on 100 snap bean plants during the fall of 1969 at Sanford, Florida.

maintained until late November when maturity and cool temperatures ended their usefulness.

In 1968 (Fig. 3) 2 bean fields were used, counts in the earlier planted field were discontinued after being sprayed with insecticide in mid-October when blooms were appearing. The eggs counted in the second planting reflect the lower abundance of butterflies after 5 days of rain and wind in mid-October. The later planting of beans had one trifoliate leaf in late October when counts began. The plant size and butterfly abundance both contributed to the low count. The peak count in early November occurred long before blooming of the plants being sampled.

During 1969 (Fig. 4) observations of bean leaf rollers showed a population peak similar to 1966 and at a similar plant maturity stage (prebloom to blooming). Butterflies were very abundant during October until early November when night temperatures dipped into the 40's. A small population continued until late November when the plants declined and butterflies were uncommon.

An early planted field in 1969 had relatively low numbers of eggs and larvae until early October when populations were greatly increasing similar to the 1966 field. Those plants had similar population levels when blooming as did later planted plants with 3 trifoliate leaves. This supports the hypothesis that butterfly numbers are more important than plant age for predicting immature populations.

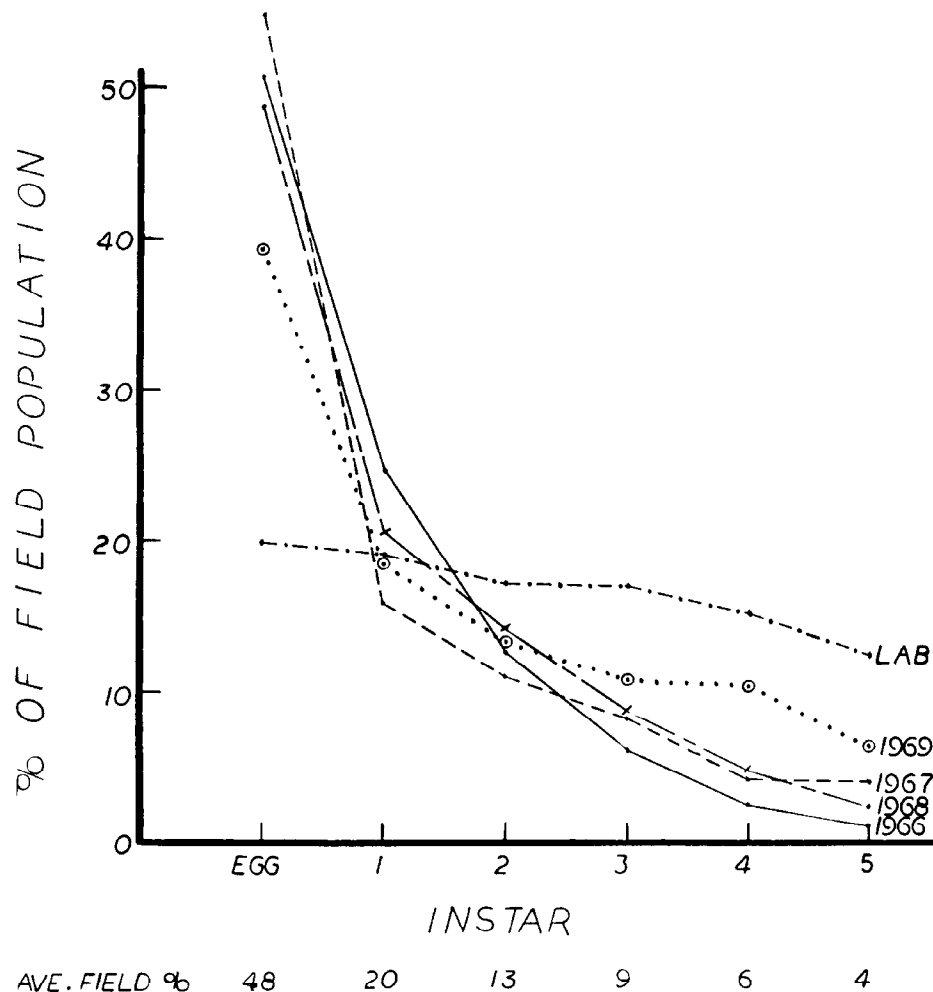


Fig. 5—Relative percentages of eggs and larval instars of the bean leaf roller counted on snap beans at Sanford, Florida.

INSTAR DISTRIBUTIONS

All field counts of natural populations were made relative to instar for the 4 year study (Fig. 5). Nearly 50% of the total individuals counted were eggs, approximately 20% first instar larvae, 13% second instar, 9% third instar, 6% fourth instar, and 4% fifth instar larvae or prepupae. These figures exemplify the large percentage of death from one life stage to the next. Even though the largest loss in numbers was from egg to first instar, over 50% less first instar larvae than eggs, the loss from the population was considerable at each instar. About 4% of the total number counted were last instar larvae resulting in much less than 4% of the eggs producing adults after pupal loss. Probably about 2% of the eggs reached the adult stage, meaning for each 100 eggs laid, 1 female would result. Field collected eggs or larvae reared in the laboratory produced pupae which were nearly 50% males and 50% females.

In Fig. 5 a line is plotted of data from laboratory reared larvae to show results when mortality from predators and parasites is eliminated and to compare with field mortality data. The line is relatively flat, indicating that field mortality resulted from causes other than natural deaths. All lines from the third to fifth instar were similar in slope for the laboratory and field populations. Earwigs, *Labidura riparia* (Pallas), were observed feeding on prepupae in the field.

REARING TIME

The time required for development of the bean leaf roller was recorded for constant temperatures during 1968 (Table 1). The 65° chamber was almost too cool for larval development. The larvae were very sluggish and appeared to feed less than those in warmer temperatures, they weighed less at each molt and only 6 of 100 larvae pupated. Larvae and eggs were placed in a 60° chamber and did not survive after 4 weeks, but most larvae survived the first week. At 75° approximately 34 days were required for egg and larval development, of which 15 days were spent in the last instar and prepupal period. For each increase in 10°, total development time reduced by one-half. Assuming outside temperatures average 75° during late September and early October, then fifth instar larvae should be found about 19 days after eggs are observed in the field. Raw data from 1967, 1968, and 1969, show that fifth instar larvae were found 24, 11, and 14 days after eggs were recorded. These days of development are very relative, but do relate to the development time from egg to last instar.

TABLE 1.—AVERAGE HOURS REQUIRED FOR DEVELOPMENT OF THE BEAN LEAF ROLLER AT 4 CONSTANT TEMPERATURES. DATA ARE FROM 100 EGGS AND 100 LARVAE AT EACH TEMPERATURE.

Chamber temperature in °F	Eggs	Instar					Total	Pupae
		1	2	3	4	5		
65	209	153	154	287	282	436	1521	660*
75	108	66	74	85	135	360	828	411
77	101	58	67	69	82	272	649	—
85	68	48	42	53	67	143	421	209

*Only 6 larvae pupated in the 65° chamber.

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