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USE OF LIFE TABLES TO ASSES HOST PLANT RESISTANCE IN COWPEA TO *APHIS CRACCIVORA* KOCH (HOMOPTERA: APHIDIDAE)

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ABSTRACT:

The effects of seven cowpea cultivars on the development periods and some life table parameters on bean aphid *Aphis craccivora* Koch, were studied in the laboratory. Data revealed that the duration period of nymphal stages ranged from 7.22 d on Six-Weeks to 8.19 d on B-Crowder cultivar. Aphid individuals fed on Six-Weeks cultivar developed significantly faster than those on any other cultivars, whereas, it was longer development time was on B-crowder cultivar.

The intrinsic rate of natural increase (rm) for *A.craccivora* on IT82 D889 cowpea cultivar was the highest. The estimates of (rm) varied from 0.271 on IT82 D889 to 0.190 on Balady.The mean doubling time (DT) of aphid population on these cultivars ranged from 2.68 to 3.65 d. at 25 ^{o}C. The reproductive rate (R_0) ranged from 28.42 individuals on IT82 D889 to 15.23 individuals on Tvu-21. Based on life- table analysis of cowpea aphid populations, it could be concluded that IT82 D889 was the most suitable host plant for *A.craccivora* while development on B-Crowder was the least suitable.

INTRODUCTION:

Cowpea, *Vigna unguiculata (L) Walp* is widely grown in the tropics and subtropics as primary source of vegetable protein. However, it is subjected to heavy losses or entire crop failure as a result of severe insect pest perdition (Singh and Van Emdan, 1979). The cowpea aphid, *Aphis craccivora* Koch has recently became an important pest of the crop in several parts of Africa (Singh, 1987).

The aphid feeds on stem, terminal shoots and petioles of seedlings and, as the plant matures, flowers and pods (Jackai and Daoust, 1986). Aphids also affect cowpea yields indirectly by transmitting viruses (Raheja and Leleji, 1974; Atiri, *et al*, 1984).

This investigation was undertaken to evaluate the effects of resistance in Cowpea cultivars on *A.craccivora* by using life table parameters.

MATERIALS AND METHODS:

The source of *A.craccivora* were colonies derived from field collected individuals, established and maintained on cowpea seedlings (Azmerly variety) planted in plastic cups in screened cages (60 x 60 x 90 cm) inside rearing room, where temperature and relative humidity fluctuated between 25-31^{0}C and 58-85%, respectively.

Seven different Cowpea cultivars (Pinkeye, Chinese-Reds, Black-Crowder, Balady, Tvu-21, Six-Weeks and IT 82 D889) were used. Cowpea cultivars were grown in pots contained soil composed of clay-loam, sand, peat moth and nutrite fertilizer under greenhouse conditions.

First instar nymphs were placed in separate petri dish with a disc of cowpea cultivar lind with damp tissue paper. Petri dishes placed in incubator adjusted to 25^0C. For each Cowpea cultivar 20 individuals of the 1^{st} instar nymphs of *A.craccivora* were reared. Cowpea cultivar leaf disc was replaced daily. Also, observation on moulting, number of progeny and mortality were recorded daily.

Data obtained were used to evaluate the duration of nymphal instars and calculate the fecundity and life table parameters according to Birch (1948).

From these data, the intrinsic rate of increase (rm) was calculated from the equation:

$$\sum e^{-rm}.\ lx\ mx = 1$$

Where (lx) is the survival rate and (mx) is the age-specific fecundity rate.

RESULTS AND DISCUSSION:

A development period for the immature stages on the seven different cowpea cultivars is presented in Table (1). There were significant differences in length of time till adult emergence among the populations reared on different cultivars. Aphid individuals fed on Six-Weeks developed significantly faster than those fed on any other tested cultivars during the immature stages. In contrast, the aphid individuals fed on B-Crowder and Tvu-21 had significantly longer development time (≈8d) from first instar to adult than did individuals fed on Ch-Reds and Six-Weeks (≈ 7d). Also, the development periods for individuals fed on Pinkeye, Balady and IT82 D889 (≈ 8d).

Age-specific survival (lx) (the number of individuals alive at age (x) as proportion of one is shown in Fig. (1-2). Generally, longevity was shorter on Ch-Reds and B-Crowder cowpea cultivars than on other tested cultivars.

A rapid declination in the survival curve occurred on Ch-Reds, Six-Weeks and B-Crowder from 8 days through 22 days. The longest individuals female longevities on IT82 D889, Pinkeye, Tvu-21, Six-Weeks, Balady, Ch-Reds, and B-Crowder were recorded at 35, 34, 34, 34, 33, 28, and 27d, respectively.

Age-schedules of births, or age-specific fecundity rates (mx) are illustrated in (Fig. 1-2) as the number of young born per day per female alive each day. Fecundity rates on all cowpea cultivars reached a peak early in the reproductive period, followed by decline. The greatest numbers of young were produced on Pinkeye and IT82 D889 cowpea cultivars. Whereas, the lowest numbers of individuals were produced on Ch-Reds and B-Crowder cultivars.

Table (1): Means±SE developmental periods (days) of immature stages of *A.craccivora* on seven different cowpea cultivars under laboratory conditions (25 °C) and 65 ±5 RH%

Cowpea Cultivars	Duration's (in days)						
	No.	1^{st} instar	2^{nd} instar	3^{rd} instar	4^{th} instar	pre-viviparity Period	life span
Pinkeye	27	1.66 ± 0.22a	1.80 ± 024 a	1.72 ± 0.19 a	1.78 ± 0.23 a	1.00 ± 0.19 a	7.96 a
Ch-Reds	21	2.21± 0.25 b	1.52 ± 0.16 b	1.51 ± 0.14 a	1.30 ± .090 b	0.82 ± 0.13 a	7.36 b
Tvu-21	27	2.14± 0.15 b	1.83 ± 0.15a	1.66± 0..21a	1.62 ± 0.11 a	0.80 ± 0.15 a	8.05 a
Six-Weeks	27	1.91±0.17 ab	1.62 ± 0.20 b	1.64 ± 0.29a	1.19 ± 0.13 b	0.86 ± 0.22 a	7.22 b
B-Crowder	27	2.20± 0.14 b	2.00 ± 0.26 a	1.56 ± 0.14 a	1.43 ± 0.14 b	1.00 ± 0.20 a	8.19 a
Balady	27	1.75 ± 0.22 a	1.85 ± 0.20 a	1.62 ± 0.11a	1.71± 0.80 a	0.66 ± 0.15 a	7.59 b

IT 82 D889	**27**	**2.00 ± 0.16 b**	**1.92 ± 0.22 a**	**1.66 ± 0.14 a**	**1.18 ± 0.25 b**	**0.90 ± 0.24 a**	**7.66 b**

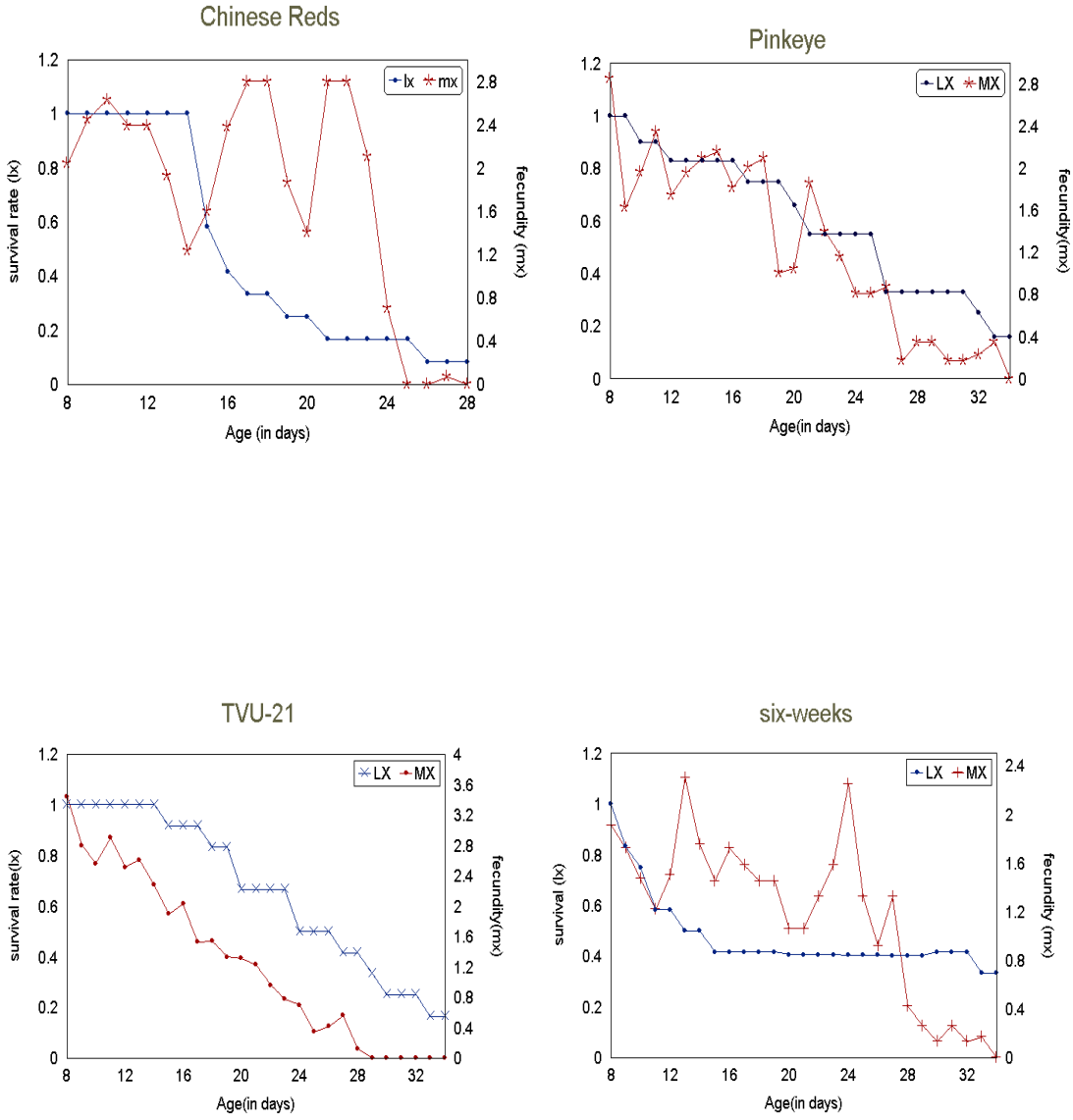

Fig. (1-2) Survival (lx) and reproduction (mx) rates of *A. craccivora* on seven different cowpea cultivars at 25^{0}C.

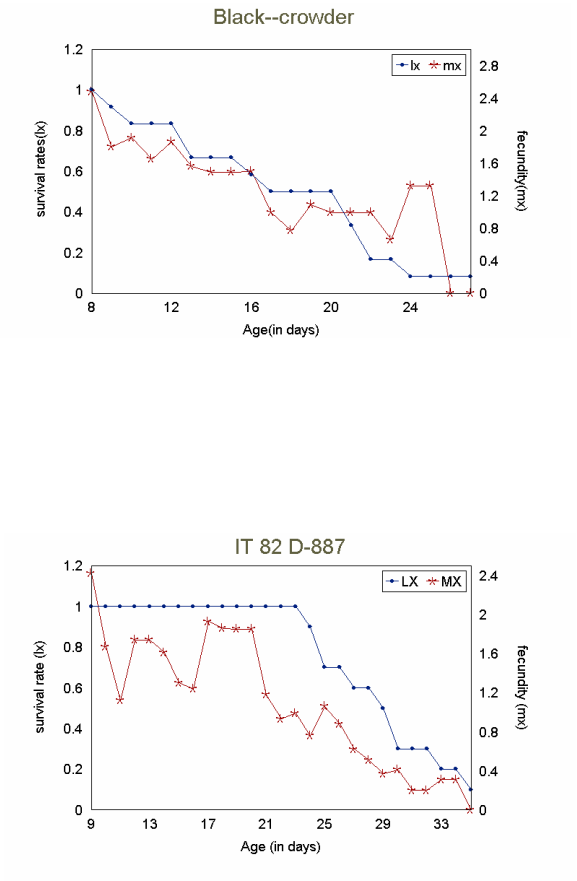

Fig. (1-2) Survival (lx) and reproduction (mx) rates of *A. craccivora* on seven different cowpea cultivars at 25^{0}C.

The highest numbers of individuals were recorded from 8 to 23 days after emergence, with values of 2.7, 2.7, 3.6, 2.9, 2.6, 2.7, and 2.3 nymphs per day on Pinkeye, Ch-Reds, Tvu-21, Six-Weeks, B-Crowder, Balady and IT82 D889, respectively.

Generally, the number of nymphs per female per day on Tvu-21 and Six-Weeks cultivar was higher than that on other cultivars, and the reproductive periods on the two cultivars lasted as long as adult longevity.

Life table statistics of the population on 7 cowpea cultivars are summarized in Table (2). *A.craccivora* reared on IT82 D889 cultivar had significantly higher intrinsic rate of increase (rm=0.271) and higher net reproductive rates (R_0=28.42 time (number of female offspring per female) than aphid reared on other cultivars. There were no significant differences in rm values among the populations on Ch-Reds, Six-Weeks, and Balady, which was 0.210, 0.193, and 0.190, respectively.

Mean generation times (T) ranged from ≈ 11 to 15 d. Mean doubling time for *A.craccivora* populations varied from ≈ 2.7 d on Tvu-21 to ≈ 3.7 d on Balady cultivars.

The figures were converted to finite rates of increase (λ), i.e., the number of individuals added to the population per female per day, from the relation λ=antilogy, rm. For example, on Pinkeye cultivar, λ=antilogy 0.252=1.29, or the population has the capacity of multiply 1.29 times per female per day. At the end of 1 week

each female could contribute 1.29 or 59 individuals to the population.

It could be demonstrated that cowpea cultivars had significant effect on both the longevity and fecundity *A.craccivora* females. These results are in general agreement with the observations for *B.tabaci* by other outhers (Azab *et al*, 1971, Burtler *et al*, 1983).

Van lantern and Noldus (1990) stated that shorter development times and greater total oviposition on a host reflect the suitability of the plant. Therefor, *A.craccivora* populations that fed on IT82 D889, Tvu-21 and Pinkeye showed higher intrinsic rates of increase resulting from faster development, higher survivorship and oviposition rates, these 3 species are presumably more suitable hosts for this pest.

Siddiqui and Barlow (1973) showed that temperature, affected pea aphid longevity, development time, total fecundity and fecundity rate, all of which influence the intrinsic rate of increase. Host plant resistance decreased size and fecundity of the spotted alfalfa aphid generally predicted by Painter (1951).

Table (2): Life table parameters of *A. craccivora* reared on seven different Cowpea cultivars under Constant temperature (25 °C).

Cowpea Cultivars	R_0	T	DT	rm	λ	No. of aphids after one week
Pinkeye	20.14	11.93	2.75	0.252	1.29	59
Ch-Reds	22.24	14.75	3.30	0.210	1.23	42
Tvu-21	15.23	10.52	2.68	0.259	1.30	62
Six-Weeks	24.75	16.62	3.59	0.193	1.21	38
B-Crowder	16.29	11.50	2.85	0.243	1.28	56
Balady	17.22	14.95	3.65	0.190	1.21	38
IT 82 D889	28.42	12.36	2.75	0.271	1.31	66

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استخدام جداول الحياة في تقدير مقاومة اللوبيا لمن البقوليات

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تم دراسة تأثير ٧ أصناف من اللوبيا على معدل التطور وبعض خصائص جداول الحياة لمن البقوليات (*A.craccivora*) تحت الظروف المعملية. أوضحت النتائج أن أعمار الحوريات لمن البقوليات تتراوح بين ٧.٢٢ يوم على الصنف (Six-Weeks) إلي ٨.١٩ يوما على الصنف B-Crowder.

ويتضح من ذلك أن أفراد المن التي تغذت على صنف اللوبيا Six-Weeks تطورت بسرعة معنوية عالية بالمقارنة بالأصناف الأخرى. بينما أخذت الأفراد التي تغذت على الصنف B-Crowder وقتا أطول. ووجد أن معدل الزيادة الطبيعي (rm) كان عاليا على الصنف IT82 D889 (٠.٢٧١)، بينما كان معدل الزيادة الطبيعي منخفضا ٠.١٩٠ وسجلت على الصنف البلدي. ووجد أن معدل الزمن اللازم لتضاعف المجموع الحشري (DT) لمن البقوليات يتراوح بين ٢.٦٨ على الصنف Tvu-21 إلى ٣.٦٥ على الصنف البلدي على درجة حرارة ٢٥م. كما وجد أن معدل التضاعف خلال جيل واحد R_0 تتراوح بين ٢٨.٤٢ على الصنف IT82 D889 إلي ١٥.٢٣ على الصنف .Tvu-21.

وبناء على تحليل جداول الحياة لمن البقوليات لوحظ أن الصنف IT82 D889 كان اكثر الأصناف ملائمة لتطور حشرة المن بينما كان الصنف B-Crowder اقلها ملائمة لهذه الحشرة.