References

Abdul-Baki, and Anderson. J.D., (1973). Vigour determination in soybean seed by multiple criteria *Crop Sci.*, **13**: 360-363.

Gurusamy, C. (1996). Studies on the pattern of seed development, maturation anddeterioration in cauliflower (*Brassica oleracea L.* Var botrytis) cv. Kibo giant. M.Sc. (Ag.) Thesis Tamil Nadu Agricultural University, Coimbatore.

Ista, (1999). International rules for seed testing. *Seed Sci. & Technol.*, **27**: Supplement rules, 27-31

Kolay, A.K. (1993). Basic concepts of soil science. Published by V.S. Johri for Wiley Estern Limited, New Delhi. pp. 225-234.

Lakshmi, S. (1995). Nutrient management to augment flower and pollen production in male parent (TCB 209) of cotton TCHB 213. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Mehetre, S.S., Tendulkar, A.V. and Darade, R.S., (1990). Effect of foliar application of Diammonium phosphate and Napthalene Acetic Acid on seed cotton yield and fibre properties of *Gossypium hirsutum L. Cotton ISCI Journal*, **15**(2): 145-147.

Nargis, S. (1995). Influence of pelleting, magnetic treatment and radiation on the performance of differentially aged seeds in tomato (*Lycopersicon esculentum* Mill) cv. PKMI. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Panse, V.S. and Sukhatme, P.V., (1995). Statistical methods for agricultural workers. ICAR, New Delhi, p.330.

Pothiraj, P., Jaganathan, N.T., Venkitasamy, R., Premsekar, M., and Purushothaman, S. (1995). Effect of growth regulators in cotton MCU 9. *Madras Agric. J.*, **82**(4) : 283-284.

Rajendran, R. (1991). Response of greengram (CO 4) to soil and foliar nutrition. *Madras Agric. J.*, **78**: 9-12.

Sabir-Ahamed, A. (1989). Studies on the production of quality seed and storage in soybean (Glycine max (L.) Merrill) M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Sharma, R.K., L.D. Koshta, T.S.Johar and A.K. Agrawal. (1991). Response of DAP spray on the yield of gram in medium black soils of Sagar district (M.P.).

Vanangamudi, K., Palanisamy, V., Ponnusamy, A.S. and Karivaratharaju, T.V. (1987). Quality seed production of cotton. *Seeds and Farms.* **13**(6) : 30-33.

Woodstock, L. and Feeley. J., (1965). Early seedling growth and initial respiration rates as potential indicators of seed vigour in corn. *Proc. Ass. Off. Seed analyst*, **55**: 131-139.

(Received : August 1999; Revised : November 2000)

Madras Agric. J., 87(4-6): 206 - 210 April - June 2000
https://doi.org/10.29321/MAJ.10.A00445

Life table studies of the diamondback moth *Plutella xylostella (L.)* on cauliflower, cabbage and mustard

C. GALICE LEO JUSTIN, M.GANESH KUMAR AND M.SWAMIAPPAN

Horticultural Research Station, Tamil Nadu Agricultural University, Pechiparai - 629 161

Abstract : Life table studies on cauliflower, cabbage and mustard showed that DBM had a gross reproductive rate of 89.16, 115.40 and 86.78 female eggs per female on the above three crops. The species had a capacity for natural increase of 0.16, 0.17 and 0.13 females per day on cauliflower, cabbage and mustard with a (daily finite rate of increase) of 1.18, 1.19 and 1.14 females per day, the population would multiply 3.18, 3.38 and 2.50 times every week. (*Key Words : Intrinsic rate of increase, Finite rate of increase, Gross reproductive rate, Plutella xylostella)*

The Diamondback moth (DBM), *Plutella xylostella* (L.) (Lepidoptera : Plutellidae) is an important pest of cruciferous crops and enjoys worldwide distribution (Chelliah and Srinivasan, 1986). Among several crucifers, the pest exhibits a marked preference for cauliflower and cabbage which provide olfactory and gustatory stimuli for successful host selection and development (Singh

and Singh, 1982). The present investigation elucidates the life table statistics of this pest when reared on cauliflower, cabbage and mustard.

Materials and Methods

For life table studies on cauliflower, plants were kept in wooden insect rearing cages (60 x 45cm) and freshly-emerged adults were released for egg laying. For life table studies on cabbage, cabbage leaves rooted by placing their petioles in water in glass vials were kept in insect rearing cages. Freshly-emerged adults were released for egg laying. For life table studies on mustard, freshly-emerged adults were released inside wooden insect rearing cages on Indian mustard seedlings for egg laying. For life table studies, 100 freshly laid eggs were placed in 10 plastic containers (20x15cm) in batches of 10 each. The freshly hatched larvae were reared on cauliflower, cabbage and mustard separately upto pupation and emergence. For each host plant, three replications were maintained. Data on hatchability, larval and pupal duration, age-specific mortality and fecundity of the adults were recorded.

The life tables were prepared with the help of fecundity and later the intrinsic rate of natural increase of population was calculated by using Birch's (1948) formula as elaborated by Howe (1953)

$$e^{-r}\, m^{x} lxmx = 1$$

Where 'e' is the base of natural logarithms, 'X' the age of the individuals alive at the age 'X' as a proportion of one and 'mx' the number of female offsprings produced per female in the age interval 'X'. The sum of products 'lxmx' is the net reproductive rate Ro, the rate of multiplication of population for each generation measured in terms of females produced per generation. The approximate value of cohort generation was calculated as follows:

$$T_c = \frac{lx.mx.X}{lx.mx}$$

The arbitrary value of innate capacity for increase 'rc' was calculated from the formula :

$$r_c = \frac{\log_e Ro}{T_c}$$

The precise generation time 'T' was then calculated from the formula :

$$T = \frac{\log_e Ro}{rm}$$

and the finite rate of increase (T) was determined as = e^{r}_{m}.

Results and Discussion

The average duration of immature stages of DBM was 21 days on cauliflower (Table 1), 22 days on cabbage (Table 2) and 25 days on mustard (Table 3). The pre-oviposition period lasted for three days in all the host plants tested. The survival from egg to adult emergence was 97.6, 98.4 and 93.6 per cent on cauliflower, cabbage and mustard respectively. The maximum longevity of the reproductive female was 16, 16 and 15 days on cauliflower, cabbage and mustard. The gross reproductive rate (GRR) of the species was 89.16, 115.40 and 86.78 female eggs per female on the above three crops respectively (Table 4). The value of Ro was 74.82, 103.44 and 64.47 indicating thereby that the population of DBM was able to multiply 74.82, 103.44 and 64.47 times on the three crops in the generation time (T) of 26.59, 27.18 and 30.94 days respectively. The species had a capacity for natural increase of 0.16, 0.17 and 0.13 females per day on cauliflower, cabbage and mustard with a daily finite rate of increase (λ) of 1.18 and 1.14 females per day, the population would multiply 3.18, 3.38 and 2.50 times every week.

The average duration of immature stages was 21 days on cauliflower (Table 1), 22 days on cabbage (Table 2) and 25 days on mustard (Table 3). These observations more or less confirmed the findings of Chelliah and Srinivasan (1986) and Chauhan *et al.* (1994). The survival from egg to adult emergence was 97.6, 98.4 and 93.6 per cent on cauliflower, cabbage and mustard respectively. Among the three host plants, cabbage was the most preferred followed by cauliflower and mustard as reflected by the intrinsic rate of increase and gross reproductive rate (Table 4). Shorter generation time (T) may be attributed to increased feeding and reduction in the developmental time (T_c)

Chauhan *et al.* (1994) reported that the population of DBM was able to multiply 85.47 times on cauliflower in the generation time (T) of 29.84 days. The present estimates of 'rm' was considerably lower than 0.213 as reported by Liu *et al.* (1985) at a constant temperature of 25° C when reared on kale and higher than 0.155 as reported by Chauhan *et al.* (1994) on cauliflower. Besides host, faster rate of development as affected by fluctuating temperature (Cloudsley-Thompson, 1953) could be the possible reason for lower 'rm' value as determined in the present findings. Similar observations on the influence of host plants on the life table parameters of *Spodoptera litura* Fab. on cotton and castor (Balasubramanian *et al.* 1988), *Heliothis armigera* (Hub.) on different food plants (Dhandapani, 1979) were reported.

Table 1. Life table (for females), age-specific fecundity for DBM on cauliflower

Pivotal age (days) X	Survival of females at age X lx	Number of females / female mx	lxmx	lxmxX
0-21		Immature stages		
21-23		Pre-oviposition period		
24	0.88	14.60	12.85	308.35
25	0.88	9.76	8.59	214.72
26	0.88	13.53	11.91	309.57
27	0.86	12.66	10.89	293.97
28	0.86	9.36	8.05	225.39
29	0.86	7.56	6.50	188.55
30	0.86	5.43	4.67	140.09
31	0.76	8.12	6.17	191.31
32	0.76	3.15	2.39	76.61
33	0.74	1.75	1.30	42.74
34	0.74	0.75	0.56	18.87
35	0.72	0.45	0.32	11.34
36	0.62	0.79	0.49	17.63
37	0.14	0.63	0.09	3.26
38	0.12	0.43	0.05	1.96
39	0.01	0.43	0.00	0.07
40	0.00	0.00	0.00	0.00
Total		89.16	74.82	2044.42

Table 2. Life table (for females), age-specific fecundity for DBM on cabbage

Pivotal age (days) X	Survival of females at age X lx	Number of females / female mx	lxmx	lxmxX
0-22		Immature stages		
22-24		Pre-oviposition period		
25	0.98	21.26	20.83	520.87
26	0.96	12.45	11.95	310.75
27	0.96	22.34	21.45	579.05
28	0.86	18.44	15.86	444.04
29	0.84	13.60	11.42	331.30
30	0.84	8.36	7.02	210.67
31	0.84	6.24	5.24	162.49
32	0.82	5.78	4.74	151.67
33	0.82	2.16	1.77	58.45
34	0.76	1.36	1.03	35.14
35	0.74	0.86	0.64	22.27
36	0.70	0.64	0.45	16.13
37	0.70	0.66	0.46	17.09
38	0.56	0.54	0.30	11.49
39	0.49	0.48	0.24	9.17
40	0.12	0.23	0.03	1.10
41	0.00	0.00	0.00	0.00
Total		115.40	103.44	2881.69

Table 3. Life table (for females), age-specific fecundity for DBM on mustard

Pivotal age (days) X	Survival of females at age X lx	Number of females / female mx	lxmx	lxmxX
0-25		Immature stages		
25-27		Pre-oviposition period		
28	0.84	13.46	11.31	316.58
29	0.84	9.26	7.78	225.57
30	0.76	14.56	11.07	331.97
31	0.76	12.26	9.32	288.85
32	0.72	10.64	7.66	245.15
33	0.72	9.36	6.74	222.39
34	0.70	6.10	4.27	145.18
35	0.62	5.43	3.37	117.83
36	0.62	2.24	1.39	50.00
37	0.56	1.24	0.69	25.69
38	0.56	0.56	0.31	11.92
39	0.46	0.44	0.20	7.89
40	0.46	0.55	0.25	10.12
41	0.26	0.42	0.11	4.48
42	0.01	0.26	0.00	0.11
43	0.00	0.00	0.00	0.00
Total		86.78	64.47	2003.72

Table 4. Net reproductive rate, generation time, innate capacity for increase and finite rate of increase in number of DBM on cauliflower, cabbage and mustard

Parameters	Cauliflower	Cabbage	Mustard
Gross Reproductive Rate (GRR)	89.16 female eggs/female	115.40 female eggs/female	86.78 female eggs/female
Net Reproductive Rate (Ro)	74.82 female eggs/female	103.44 female eggs/female	64.47 female eggs/female
Mean length of generation Tc	27.32 days $\frac{\Sigma lxmx}{Ro}$	27.86 days	31.08 days
Innate capacity for increase in number	0.16 females/day $r_c =$	0.17 females/day $\frac{\log_e Ro}{Tc}$	0.13 females/day
Intrinsic rate of increase rm = e7-rm lxmx	0.163 females/day	0.171 females/day	0.135 females/day
Correlated generation time	26.59 days $T=$	27.18 days $\frac{\log_e Ro}{rm}$	30.94 days
Finite rate of increase in number antilog (erm)	1.18 females/day	1.19 females/day	1.14 females/day
Weekly multiplication of population (erm)^7	3.18	3.38	2.50

Wakisaka *et al.* (1992) also observed the variation in the reproductive ability, adult longevity, preovipositional period and fecundity of DBM when fed on broccoli, Chinese cabbage which were significantly higher than when fed on a wild crucifer Capsella bursa-pastoris. They also reported on the influence of temperature and nutrition of host plants in the survival of immature stages and reproduction of adults.

References

Balasubramanian, G., Chelliah, S., Balasubramanian, M. and Gopalan, M. (1988). Life table and intrinsic rate of increase of *Spodoptera litura* Fab. on castor and cotton. *Entomon,* **13**: 141-145.

Birch, L.C. (1948). The intrinsic rate of increase of an insect population. *J.Anim.Ecol.* **17**: 15-26.

Chauhan, U., Sharma, K.C., Varma, A.K. and Bhalla, O.P.(1994). Growth rate of the diamondback moth, *Plutella xylostella* on cauliflower. *Entomon,* **19**:3-4.

Chelliah, S. and Srinivasan, K. (1986). Biology and management of diamondback moth. In *Diamondback moth management.* (Talekar, N.S. and Griggs, T.D. eds.) Proc. 1st Intl. Workshop, 1985, AVRDC, Taiwan. pp. 63-76.

Cloudsley Thompson, J.L.(1953). The significance of fluctuating temperatures on the physiology and ecology of insects. *Entomologist,* 86:183-189.

Dhandapani, N. (1979). Food utilisation and life table studies of *Heliothis armigera* (Hub.) (Noctuidae: Lepidoptera) on eight different food plants. M.Sc.(Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore.

Howe, R.W. (1953). The rapid determination of intrinsic rate of increase of an insect population. *Annals Appl. Biol.* 40:134-155.

Liu, H., Chen, C.N. and King, K.S. (1985). The population parameters of the diamondback moth, *Plutella xylostella* (L.) on common kale. *Plant Prot. Bull. Taiwan.* **27**:145-153.

Singh, S.P. and Singh, D. (1982). Influence of cruiferous host plants on the survival and development of *Plutella xylostella L.J.Res. Punjab Agric. Univ.* **19**:100-104.

Wakisaka, S., Tsukuda, R. and Nakasuji, F. (1992). Effect of natural enemies, rainfall, temperature and host plants on survival and reproduction in the diamondback moth. In: *Diamondback moth and cruifer pests* (Talekar, N.S. ed.). Proc. 2nd Intl. Workshop, 1990, AVRDC, Taiwan, pp.15-26.

(Received : December 1998; Revised : July 2000)

Madras Agric. J., 87(4-6): 210 - 217 April - June 2000

Prediction of potential yield of rice across India through simulation modelling

S. RAMASAMY

Agricultural Research Station, Ramanathapuram - 623 501. Tamil Nadu.

Abstract : An analysis of rice growth and its performance (cv IR 72) across India by a simulation study utilizing the historical mean weather data confirms that rice could be cultivated throughout India. The potential grain yields vary from 9.34 to 13,98 t ha^{-1} between 9°08' and 31°25'N latitude. The potential yield is increasing for increasing latitudes (9° to 23°N) and elevation (0 to 900m MSL). The growth duration varies (100 to 146 days) depending upon the geographical location. Suitable times for sowing also varies from all the 12 months in the South to a short period of only 4 months in the North. Optimum time of sowing for most of the locations in India seems around 15-June. It could be concluded that a detailed more realistic prediction is possible by simulation models, provided day wise more precise weather data including solar radiation is available for the testing centers. *(Key Words : Simulation model, Potential grain yield, Optimum sowing period, Growth duration)*

Rice research is predominant among agricultural scientific community. There is constant attempt by the scientists, to evolve newer high yielding genotypes to replace the existing ones; to find out newer cultural management practices to enhance the productivity; and to find out the causes for the yield decline in some parts of the rice growing environments etc. But the time required