high mean performance show greatest benefit in high yielding environment. However, increasing mean performance has tended to decrease area adaptation and stability owing to genotype x environment interaction. In the present investigation, the sum of squares for the parents, hybrids and parents vs. hybrids interacted significantly with the environment for almost all the characters. The general and specific combining ability variances and their effects were also effected by change in environment i.e. timely vs. late sown.

To maintain production in diverse environment it would be desirable to increase the genetic diversity within the cultivar which can be achieved by postponing the selection in early generation to maintain within line variation. Thereafter, selection can be done for performance and uniformity (Baenziner and Peterson, 1991). An alternative approach to widen genetic diversity is to develop multilines.

ACKNOWLEDGEMENT

The first author is grateful to Dr. B. Snoad (England), Dr. S. Blixt (Sweden), Dr. A.E. Slinkard (Canada) and Dr. J.M. Kraft (USA) for providing pea germplasm lines.

REFERENCES

BAENZIGER, P.S. and PETERSON, C.J. (1991). Genetic variation : Its origin and use for breeding self-pollinated species. P. 69-91 In: Stalker, H.T. and Murphy, J.P. (Eds.). **Plant Breeding in the 1990s.** CAB International.

GRITTON, E.T. (1975). Heterosis and combining ability in a diallel cross of pea. **Crop Sci., 15:** 453-457.

KEMPTHORNE , O. (1957). **An Introduction to Genetical Statistics.** John Wiley and Sons, Inc., New York.U.S.A.

KATIYAR, R.P., RAM, R.S. and MAURYA, D.M. (1987). Combining ability for phenological and physiological traits in pea. **Indian J. Genet., 47:** 281-289.

KUMAR, H.and AGRAWAL, R.K. (1981). Combining ability analysis of certain productive traits in pea (*Pisum sativum* L.). **Z. Pflanzenzuchtg. 86:** 110-116.

KUMAR, H. and AGRAWAL, R.K. (1982). Genetic analysis of flowering in pea - Two 10 x 10 diallel sets involving exotic and Indigenous cultivars. **Genet. Agr. 36:** 31-34.

PANDA, P.K., SINGH, K.P. and KAR, R.M. (1996). Combining analysis for some quantitative characters in garden pea (*Pisum sativum* L.). **Ann. agric. Res., 17:** 230-234.

SARAWAT, P., STODDARD, F.L., MARSHALL, D.R. and ALI, S.M. (1994). Heterosis for yield and related characters in pea. **Euphytica, 80:** 39-48.

VENKATESWARLU, S. and SINGH, R.B. (1983). Combining ability over environments in pea. **Indian J. Genet. 43 :** 185-187.

(Received: March 1998 Revised: September 1998)

Madras Agric. J., 86(7-9): 370 - 372 July - September 1999
https://doi.org/10.29321/MAJ.10.A00620

PREDATION POTENTIAL OF *Coccinella septempunctata* var *divaricata* OLIVE ON MUSTARD APHID (*L. erysimi* Kalt.) INFESTING MUSTARD CROP

SEEMA KUMARI and I.P. SINGH

Department of Entomology & Agril. Zoology
Rajendra Agricultural University
Pusa, Samastipur, Bihar - 848 125

An experiment was conducted to study the predation potential of *Coccinella septempunctata* var *divaricata* on mustard aphid during February-March, 1996. The larva of the predatory Coccinellid consumed 116.61 aphids per individual with minimum and maximum of 155.5 and 167.71 aphids per individual in February while 141 aphids per individual with minimum and maximum of 114.25 and 168.75 aphids per individual in March. Adult of the Coccinellid consumed 518.0 aphids per individual with minimum and maximum of 428 and 636 aphids per individual in March.

KEY WORDS: *C. septempunctata var. divaricata,* Mustard aphid, Mustard

Among the oilseeds, mustard (*Brassica juncea* L.) is very important crop extensively cultivated throughout India. As many as 38 insect pests are reported to be associated with this crop but mustard aphid (*Lipaphis erysimi* Kalt) is recorded as key pest of this crop in India (Bakhetia,

1987). Predatory coccinellids play an important role in the population management of mustard aphid (Sinha *et al.*, 1982). Bio-control agents are important components of IPM. It is very essential to know the predation potential of bio-control agents to be incorporated in IPM. *C. septempunctata* var. *divaricata* olive is an important predatory Coccinellid preying upon *L. erysimi* in mustard crop ecosystem in this locality. So it is essential to know the predation potential of the Coccinellids to make it compatible with other measures of IPM.

MATERIALS AND METHODS

The experiment was carried out at P.G. Department of Entomology and Agricultural Zoology, R.A.U., Bihar, Pusa, Samastipur. The collected pupae were reared in laboratory at room temperature for adult emergence. Freshly emerged as well as field collected adults were released in pairs in petridishes (15 cm) provided with cardboard paper over its surface. The adults were provided with an adequate number of live aphid nymphs. Nymphs were collected and replaced daily for providing fresh food to beetles. Eggs laid by the gravid females on mustard twig were isolated daily. They were removed and transferred to other petridishes for further rearing and studying.

To study predation potential, counted number of freshly hatched larvae were placed in petridishes (15 cm.). First and second instar nymphs were provided as food to the first instar predator larvae, whereas subsequent instar were fed on third, fourth and well developed nymphs. Larvae soon after the first moult were separated, counted and placed singly in petridishes (10 cm.) for further rearing and observation. The process was continued till adult emergence. Observations regarding daily and total consumption of aphids by larvae of respective instar and adult of *C. septempunctata var divaricata* were recorded to determine their predation potential. The experiment was done twice, during February and March, 1996.

RESULTS AND DISCUSSION

The data showing in the table 1 and fig 1 revealed that first instar larvae consumed 81 aphids per individual during February and 86.37 aphids per individual during March. The second instar larvae consumed on an average 82.25 aphids per individual during February and 90.15 during March. Third instar larvae consumed 91.7 aphids in February and 107.5 aphids in March. The fourth instar larvae consumed 211.5 in February and 280 aphids in March. The adult consumed 580 aphids per individual with minimum and maximum of 420 and 649, respectively in February while 528 aphids per individual were consumed in March.

A critical perusal of the data in the table revealed that the single adult consumed more number of aphids than the larvae. There was no significant difference in consumption of aphids by larvae during March. The aphid consumption at third and fourth instar was higher than first and second instar larvae.

Singh and Malhotra (1979) reported that the rate of feeding among different instars varied

Table 1. Predation potential of larvae and adult of *Coccinella septempunctata* var. divaricata on mustard aphid (*L. erysimi* Kalt) during February-March, 1996

Stages larvae/adult	Total no. of aphids consumed per individual					
	February			March		
	Min	Max	Mean	Min	Max	Mean
Ist instar larvae	68	104	81.00	72	108	86.37
IInd instar larvae	78	116	82.25	78	108	90.15
IIIrd instar larvae	96	126	91.71	92	121	107.50
IVth instar larvae	204	325	211.50	215	340	280.00
Mean	111.5	167.75	116.61	114.25	168.75	141.00
Adult	420.0	649.0	518.0	428.0	636.0	528.12

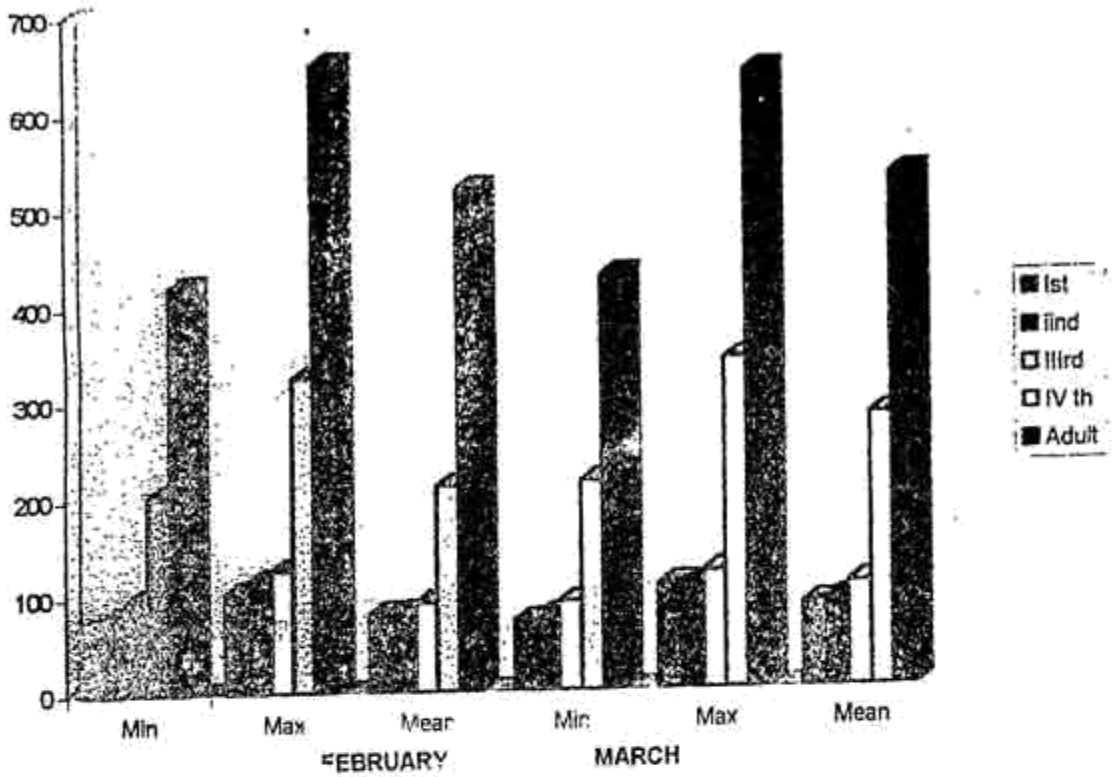

Fig. 1 Predation potential of *Coccinella septumpunctata* var *divaricata* on mustard aphid (*L. erysimi* Kalt) during Feb-Mar 1996

greatly in case of *C. septempunctata*, the first and second instar larvae consumed on an average 32.4 and 40.5 aphids, respectively and during its entire larval period 284.6 aphids were consumed and a beetle on an average consumed 95 aphids per day. Agrawala and Saha (1986) also reported that the aphid consumption at successive instar of the Coccinellid increased and was found to be 22.2, 27.8, 12.4 and 343.2 individual of *A. gossypii* with higher feeding rate at third and fourth instars. Similarly Mohamad and Mahmood (1986) reported that number of aphids consumed by *C. septempunctata* increased with increasing age of larvae and varied according to the duration of the larval instar. Debraj and Singh (1990) recorded consumption rate of Coccinellids at first, second, third and fourth instar as 35.50, 68.40, 131.60 and 288.50 individuals aphids of *A. craccivora*, respectively. These reports lend good support to the present findings.

ACKNOWLEDGEMENT

The authors are grateful to the Chairman of the Department of Entomology and Agricultural Zoology, R.A.U., Bihar, Pusa for providing the necessary facilities.

REFERENCES

AGRAWALA, B.K. and SAHA, J.L. (1986). Larval voracity, development and relative abundance of predators of aphids gossypii on cotton in India. Ecology of aphidophage (ed. by Hodek) pp. 339-344. Academia, Prague.

BAKHETIA, D.R.C. (1987). Insect pests of rapeseed and mustard and their management in plant protection in field crops, eds. M. VEERBHADRA RAO and S. SITHANANTHAM, PPAI, Rajendranagar (Hyderabad), pp. 249-259.

DEBRAJ, Y. and SINGH, T.K (1990). Biology of an aphidophagous *Coccinela transversalis* Fab. **J. Biol. Contr.** 4: 93-95.

MAHMOOD, M.A. and MAHMOOD, T.T (1986) Ecological studies on broad bean aphid *Aphis fabae* slop. (Homoptera : Aphididae) with potential voracity of important predators. **Iraqui Agric. Sci. Zabco.** 4: 33-38.

SINGH, R. and MALHOTRA, R.K. (1979). Some studies on the biology of *Coccinella undecimpunctata* Memetriesi Muls - A predator of mustard aphid **Curr. Sci.**, 48(20) 904-905.

SINHA, P.B. PANDEY, R.K., SINGH, R. and TRIPATHI, C.D. (1982). Differential response of mustard varieties to aphid, *Lipaphis erysimi* Kalt., **Indian J. Ent.** 44(4): 408.

(Received : August 1998 Revised : September 1999)