SOME STUDIES OF GROWTH, DEVELOPMENT AND FECUNDITY OF GRASSHOPPER *HIEROGLYPHUS ORYZIVORUS* CARL, (ORTHOPERTA: ACRIDIDAE) ON FOOD PLANTS IN SINDH

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ABSTRACT

Present study was conducted to investigate food preference in *Hieroglyphus oryzivorus* on five food plants viz: *Oryza sativa, Zea mays, Saccharum officinarum, Cynodon dactylon* and mixed food under laboratory conditions. Nymphal developmental period significantly prolonged on *S. officinarum* (53.50 days) followed by *O. sativa* (52.65 days). However, *Z. mays* led to significantly faster development (31.10 days) compared with *S. officinarum* and *O. sativa*. Furthermore there was no significant difference in the developmental period of nymphs either reared on *C. dactylon* or mixed food (42.35 days and 43.85 days), respectively. The number of egg-pods (3.80± 0.78) and total production of eggs (175.20±49.62) per female during entire life of insect was high on *O. sativa* than other food plants. The longevity of *H. oryzivorus* was higher on mixed food and *O. sativa* (55.20±6.70 days and 51.00±5.39 days), respectively, than that of adults fed on *Z. mays* (38.13±14.77 days), *C. dactylon* (35.20±5.90 days) and *S. officinarum* (29.50±6.13 days). *Z. mays* and *O. sativa* were found to be most preferable food plants to *H. oryzivorus.*

Key words: *Hieroglyphus oryzivorus*, Development, Fecundity, Food plants, Damage

INTRODUCTION

Hieroglyphus oryzivorus Carl is reported as major pest of paddy fields in different climatic zone of India (Uvarov, 1922; Anon, 1933). In Pakistan, it has been included in the pest of paddy, maize, jowar and sugarcane but principally it was serious pest of paddy in certain localities of Punjab and Sindh (Janjua, 1957). Similarly Karim and Riazuddin (1999) reported that *Hieroglyphus* species caused heavy defoliation in field during the months of August and September.

The young hoppers hatched out in last week of August in Dadu and Larkana districts of Sindh. The young hoppers remained confined to bunds and mound for about fortnight where they feed on *Cynodon dactylon* but dynamically on paddy leaves. When the attack is very severe, the leaves may be entirely eaten up or reduced to mere midribs or stalks. The whole field may become conspicuously stunted in growth when attack of hoppers is severe at early stage of the crop. Both hoppers and adults of *H. oryzivorus* caused extensive damage in the field. Earlier an adequate work had been done by various workers on the food selection by grasshoppers (Sinoir 1969; Bernays and Chapman 1973; Campbell *et al.,* 1974; Mulkern 1976; Uvarov 1977; Rowell 1978; Parker 1984; Hsiao, 1985; Chapman *et al*., 1988) but their findings mostly associated with field observation (wheat crop and different other vegetation) and studies had been carried out from North and Central America and Africa.

Moreover, various studies on the biology, ecology, behavior and bionomics of *Hieroglyphus* spp. had been carried out from India (Roonwal 1945, 1976 a, 1976b, 1978; Katiyar, 1957; Siddiqui 1986, 1989) and inadequate work had been done by (Irshad, 1977; Hashmi, 1994; Moizuddin, 2001; Riffat *et al.*, 2007; Riffat and Wagan 2007) from Pakistan. There was no detailed study of the effect of food on growth rate and fecundity of *H. oryzivorus* from this region. As food preferences of insects vary from place to place depending on climatic and ecological conditions of the region. Hence, this research has focused on nymphal development and fecundity of *H. oryzivorus* on different food plants with a view to obtain basic information for biomass production of *H. oryzivorus* for near future.

MATERIALS AND METHODS

Stock culture

In order to investigate the effects of various host plants on the nymphal development and fecundity of

H. oryzivorus five plants *Oryza sativa, Zea mays, Saccharum officinarum, Cynodon dactylon* (grasses with which the insect was associated during the field surveys) and combination of these all these plant were used for the experiment. Insects were grown in the green house.

Gravid females of *H. oryzivorus* were collected from Khairpur Nathan Shah district Dadu (latitude 2680°N, longitude 6850°E) during the year 2005-2006 in the months of September to November. The insects were reared in five cages measuring 16 ½, × 13 ½ cms. The cages were kept under laboratory conditions where temperature ranged between 28±2°C - 41±2°C with the relative humidity ranged from about 26- 61% during June to September. These temperature and relative humidity regimes are similar to field conditions. Eggs trays filled ¼ with fine sand then water was added in ratio of 100:15 (sand: water) by volume to achieve humidity of 70-80% for optimum oviposition. Nymphs and adults from the egg-pods were used for the subsequent experiments.

Nymphal development

Newly emerged (vermiform larva) first instars nymphs were obtained from the stock culture and were reared in glass jars (ordinary jam bottle) on the different host plants such as *O. sativa, Z. mays, S. officinarum, C. dactylon* (as single host plant with weight of 4.64g) and mixed food (combination of these all host plants, which were mixed with equal weight of 0.77g). Thus for each developmental stage at least ten specimens held individually for every host plant. Insects were reared up to adult, host plant were obtained from laboratory cultivation, 3-4 weeks old leaves were used for the experiment. Fresh leaves were served daily. Developmental period was recorded from first instar up to the adults.

Life history statistics of the adult

Newly emerged adult from the stock culture were paired (one male and one female) in glass jars filled with moist sand to one- fifth of the sand capacity to serve as oviposition medium. Ten pairs were treated individually on single plant and mixed food. Adults were maintained till their death. Pre-oviposition, oviposition period, longevity of insects, egg pods per female and number of eggs per-pod and total production of eggs was recorded.

Statistical analysis

Data obtained from experimental groups were subjected to one-way analysis of variance (ANOVA) (SPSS 10.0 Soft-ware) with repeated measures and significant means were determined using Duncan's New Multiple Range Test (DMR Test).

RESULTS

Nymphal development

Table 1 shows that the first instar while feeding on the *Z.mays* led to the fastest development of hoppers than that of nymphs fed on *O. sativa* and *S. officinarum* which took prolonged time to moult in next stage. There was no significant difference in the development of hopper fed on *C. dactylon* and mixed food. As in second instar, significantly shorter developmental period was of hopper when reared on *O. sativa* and *S. officinarum* than those fed on *Z. mays*, which led completion of development in significantly shorter. While there was no significantly different in the development of hopper fed on *C. dactylon* and mixed food. On the contrary to this, in the third instar significant slower development was in the hopper fed on the *Z. mays* followed by the hopper reared on *O. sativa*. However, there was no significant difference in the development of hopper fed on either *S. officinarum, C. dactylon* and mixed food. In case of forth instar, significantly prolonged development led to the hopper fed on *S. officinarum* followed by stadia of nymphs fed on *Z. mays*, which provided significant faster development. In the fifth instars, while feeding on *Z. mays* hopper were grown earlier compared with those fed on *S. officinarum, C. dactylon*, mixed food and *O. sativa*. In sixth instar nymphs fed on *Z.mays* completed their development in significant shorter time followed by nymphs reared on *S. officinarum.* Total nymphal period was significantly faster while feeding on the *Z. mays* (31.10days) However, *O. sativa* (52.65 days) and *S. officinarum* (53.50days) led to significant prolonged development and nymphal development was insignificant when feeding was on *C. dactylon* (42.35 days) and mixed food (43.85 days).

Life history statistics of *H. oryzivorus*

Table 2 shows that the significant shortest pre-oviposition period in the adults of *H. oryzivorus* was recorded when feeding was on *O. sativa* than that of

Z. mays. There was no significant difference in the pre-oviposition period of adults when reared on the mixed food, *S. officinarum*, and *C. dactylon*, but *C. dactylon* led to the shortest period. The oviposition period was significantly prolonged in the adults fed on *Z. mays* and *O. sativa* comparable with *C. dactylon*. However, there was no significant difference in the adults fed on *S. officinarum* and mixed food, but adults fed on *S. officinarum* took short time for the oviposition. Adult females lived longer when fed on mixed food (55.20±6.70 days) and *O. sativa* (51.0±5.39 days) but their longevity was slightly reduced on the *O. sativa*. The survival period of females while feeding on *Z. mays*, *C.dactylon* and *S.officinarum* was non-significant. The females fed on *S. officinarum* lived for short time. Adults fed on *O. sativa* gave higher number of egg-pods (3.80±0.78) followed by the females reared on the mixed food (3.00±1.05). There was no significant difference in the pod per female when adults fed on *C. dactylon* and *Z. mays* .The insect fed on *S. officinarum* laid significant least number of egg-pods.

The mean number of eggs per pod was greater among the adults fed on *O. sativa* and *C. dactylon* followed by the mixed food, while feeding on the mixed food reduced eggs per pod. However, those fed on *Z. mays* and *S. officinarum* laid the least number of eggs per pod The total production of eggs during the entire life of the female was significantly high when feeding was on *O. sativa* compared with the *C. dactylon* and mixed food female laid significantly least number of eggs when housed on the *Z. mays* and *S. officinarum* but *Z. mays* led to the greater number of eggs per pod. Insect lived longer when fed on mixed food and *O. sativa* than that of adults fed on *Z. mays*, *C. dactylon* and *S. officinarum.*

Table 1. The effects of host plants on nymphal developmental period of *H. oryzivorus*

Treatments	Mean developmental period of instar in days (Mean±SD)							
	I	II	III	IV	V	VI	Average duration	Total period
O. sativa	9.35±0.77^{d}	9.0±1.13^{c}	9.05±0.91^{d}	9.1±1.69^{c}	8.3±1.27^{c}	7.85±1.34^{c}	8.77±0.57^{c}	52.65^{d}
Z. mays	4.7±0.36^{a}	5.67±0.18^{a}	5.45±1.08^{a}	4.76±0.50^{a}	5.6±0.79^{a}	4.92±0.02^{a}	5.18±0.43^{a}	31.10^{a}
S.officinarum	8.4±2.40^{c}	8.8±0.84^{c}	7.4±1.83^{b}	10.8±1.55^{d}	8.85±1.90^{d}	9.25±0.49^{d}	8.91±1.11^{c}	53.50^{d}
C. dactylon	6.15±0.21^{b}	6.95±0.91^{b}	8.0±0.42^{c}	6.8±1.55^{b}	7.0±1.55^{b}	7.45±1.34^{b}	7.05±0.62^{b}	42.35^{b}
Mixed food	6.3±0.28^{b}	7.1±2.12^{b}	7.25±1.76^{b}	6.65±1.06^{b}	8.4±1.83^{c}	8.15±2.19^{c}	7.30±0.82^{b}	43.85^{c}

Mean in the same column sharing same letters are not significantly different from one another at 5% level of probability (DMR Test)

Table 2. The effect of various host plants on the life history in adults *H. oryzivorus*

Treatments	Pre-oviposition period (Days) (Mean± Sd)	Oviposition period (Days) (Mean ±Sd)	Longevity (Days) (Mean ±Sd)	Pods per female	Eggs per pod	Total eggs during enter Life
O.sativa	7.00±1.33^{a}	20.30±5.57^{c}	51.00±5.39^{d}	3.80±0.78^{d}	46.13±15.49^{d}	175.2±49.62^{d}
Z. mays	15.66±3.6^{d}	23.46±14.0^{d}	38.13±14.77^{c}	2.70±1.22^{b}	30.02±12.51^{a}	82.02±33.12^{b}
S.officinarum	8.90±1.28^{c}	17.85±7.73^{b}	29.50±6.13^{a}	2.50±1.26^{a}	30.92±11.25^{a}	77.90±44.86^{a}
C. dactylon	8.10±1.37^{b}	15.00±5.43^{a}	35.20±5.9^{b}	2.70±0.94^{b}	43.88±12.20^{c}	118.50±33.41^{c}
Mixed food	9.10±1.79^{c}	18.10±8.96^{b}	55.20±6.7^{d}	3.00±1.05^{c}	38.16±12.80^{b}	117.20±42.04^{c}

Mean in the same column sharing same letters are not significantly different from one another at 5% level of probability (DMR Test)

DISCUSSION

Present studies showed that *O. sativa* was significantly attacked by *H. oryzivorus* .The authors are in agreement with Uvarov (1922) and Janjua (1957). Rearing of *H. oryzivorus* on various host plants singly or as mixed food clearly shows that the type of food plant can significantly affect the development of insect. Data indicate that *S. officinarum* and *O. sativa* led to prolonged developmental period than that of other food plant treatment. According to Nzekwu and Akingbohungbe (2002) variable developmental period can occur in nature, depending on the preponderance of particular food plants in various localities. However, in localities where mixed populations of food plants are present these can serve as complements to one another. Price *et al.*, (1980) state that adequate food is expected to reduce nymphal developmental period, which was very important for the fitness and survival of insects.

In adults, feeding on the single host plant i-e *O. sativa* led to a shorter pre-oviposition period than that of *Z. mays*, mixed food and *S. officinarum*. This suggests that the former plants have qualities that enable them to promote faster maturation and oocyte development. The mean number of pods per female is high when the adult females are fed on *O. sativa*. It is generally supposed that the activity with in the endocrine system is generated by the stimulation of foregut stretch receptors during increased feeding (Hill *et al.*, 1966) during somatic growth fairly large amount of food are ingested in order that fat may develop to a point at which vitellogenic protein synthesis can begin (Mordue and Hill, 1970). Therefore, the optimal amount and quality of food are necessary pre-requisites for the development and production of eggs.

The total number of eggs per female was high when *H. oryzivorus* was fed on *O. sativa* and *C. dactylon*. This shows that the overall nutritional value of the *O. sativa* and *C. dactylon* in term of adult's fertility, is superior to that of other host plants.

Significant differences in pre-oviposition, oviposition period and longevity of insects observed in the present study might be due to qualitative as well as quantitative differences of food plants used in this investigation. Food plants poor in nutritive value might have delayed the oocyte development in *H. oryzivorus* it might be reason of prolongation pre-oviposition period in this species. The results of present study are correlated with the findings of Campbell *et al.*, 1974; Mulkern 1976; Uvarov 1977; Parker 1984; Hsiao, 1985; Chapman *et al*., 1988 and Riffat and Wagan 2007 who sported that development and fecundity of insect was affected by different host plants treatments.

Overall, it is concluded that *Z. mays* is highly favored for optimum nymphal development of *H. oryzivorus*, whereas *O. sativa* promotes high fecundity. Certain single host plants can adequately promote adult maturation and egg-pod production. Presence of large numbers of grasshoppers in same locality is on the warning side as it may cause potential future plagues. This hypothesis leads us to rear the *H. oryzivorus* on different food plants. The results of such studies will be instrumental in understanding and devising population management strategies, which might be helpful for avoiding or preventing any possible future outbreak.

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