EGG LAYING AND SURVIVAL OF THE EUROPEAN CORN BORER, *OSTRINIA NUBILALIS*, ON SORGHUM VS. MAIZE IN TWO-GENERATION ZONE OF RUSSIA

ABSTRACT

Although the European corn borer, *Ostrinia nubilalis* (Hbn.) is by far the main pest of maize, it is capable to infest other cereals including sorghum. Less is known about the insect developmental biology on sorghum as well as egg laying preferences to the crop contrary to maize. During 1992-1999 we made observations on natural infestation of sorghum vs. maize as well as conducted artificial infestation experiments at the Kuban Experimental Station, Krasnodar Territory, Russia (two-generation zone of the pest). It is shown that overwintered adults strongly prefer maize for egg laying contrary to sorghum, but during the 1st-generation flight maize is not favoured for egg laying over sorghum. However, larval mortality, especially at early instar is much higher on sorghum opposite maize what was strongly demonstrated from natural infestation observations and an artificial infestation experiment. Some other ecological peculiarities of the insect were demonstrated in respect to its infestation of sorghum.

Key words: European corn borer, *Ostrinia nubilalis*, maize, sorghum, Russia

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INTRODUCTION

Maize is one of the most important host plants of the European corn borer (ECB), *Ostrinia nubilalis* (Hbn.) all over the world. However, the species is quite polyphagous being capable to attack very many robust herbaceous wild and cultivated plants (Hodgson, 1928, etc.). In particular, it is known to infest cereals besides maize including millet (Dobrodeev, 1921) and sorghum (Painter, Weibel, 1951; Atkins et al., 1983; Wiseman, 1992; Demenichini et al., 1990). The latter, namely broomcorn, seemed to be a carrier promoted the ECB penetration into North America during the I World War from Europe (Smith, 1920).

In North America the ECB is considered as an economically important pest of sorghum (Painter, Weibel, 1951; Dicke et al., 1963). It was shown there that practically all the entries of sorghum are quite resistant to the pest during leaf whorl stage of plant development. Although a level of sorghum resistance usually drops somewhat to flowering, its resistance remains higher than that of maize (Guthrie et al., 1984, 1985; Dharmalingam et. al., 1984). Host plant resistance in sorghum is considered to govern by polygenes (Ross et al., 1982); it is a reason to suppose that recurrent selection would be effective (Atkins et al., 1983). Notwithstanding this crop occupying large territories at the North Caucasus and other regions of Russia, host plant relations of the ECB and sorghum have not been adequately studied (Frolov et al., 1995; Andriyash et al., 1995; Dyatlova, Frolov, 1995).

Studying host plant relations of the ECB one must be constantly aware of the fact that the insect is a representative of a complicated taxonomic group which is combined by very near related forms of the genus *Ostrinia* having trilobed uncus in males (Mutuura, Munroe, 1970).

It was previously proved that the adapted to dicotyledonous host plants populations of *O. nubilalis* form complicated population system together with the naryn borer, *O. narynensis* Mutuura et Munroe, the brush-legged borer, *O. scapulalis* (Walker), and the Persian borer, *O.*

persica Mutuura et Munroe, at least in the European part of the former USSR. Genetic structure of this population system is appeared to vary according to the range of humidity at territories occupied by borers (Frolov, 1994a, b).

It was proved that a shift of the ECB to maize feeding resulted in a formation of host race at least in the temperate climate of the former USSR. Apart from many distinctions, populations having adapted to maize feeding and those kept their primitive host plant relations with dicotyledonous hosts manifest evident reproductive isolation (Frolov, 1984, 1989, 1994c).

The ECB and the hemp borer, *O. narynensis* Ч *nubilalis*, inhabit the Krasnodar Territory sympatrically. The ECB develops primarily on maize, whereas dicotyledonous hosts, such as hemp, clotbur, wormwood, and common ragweed are the hosts for the hemp borer (Frolov, 1984). It was observed that larvae of both borers manifested rather strong capacity to feed on their "own" host plants even though they grew adjacent each other (Frolov, unpublished data). A specific morphological feature of *O. narynensis* (the deep invagination on inner surface of male midtibia) is determined by a recessive sex linked gene called *invagination* (*i*) (Frolov, 1984). In populations of the hemp borer frequency of *i* ranges approximately from 0.29 to 0.35; it means that only about 5% of males are expected to perform invaginated midtibiae. The other specific features of *O. narynensis*, namely hair tuft and enlarged curved scales in midtibiae, were possessed also by only few *O. narynensis* Ч *nubilalis* males. Nonetheless, about 15-20% males of *O. narynensis* Ч *nubilalis* could be identified morphologically on the basis of mentioned specific characters taken in combination.

So, the first aim of our study is to clear the biotaxonomic nature of insects inhabiting sorghum, and the second one — to investigate insect developmental biology on sorghum compared with maize at the Krasnodar Territory, North Caucasus, Russia.

The first results of this work were reported at the 18th IWGO Conference held in Romania (Dyatlova, Frolov, 1995). The investigation was partly supported by the G. Soros ISF Research Grants # NTH000 and # NTH300, and the RFBR Research Grants # 94-04-11328, # 97-04-48015, and # 99-04-48053.

MATERIALS AND METHODS

For observation of midtibial morphology in males we used larvae collected in 1985-1998 on sorghum at the Kuban Experimental Station (KES).

An artificial infestation experiment was applied at KES in 1991 to study larval survival depending on origin of the population. Insect stocks were collected during autumn of 1990 at the Krasnodar Territory (KES) on maize and wild dicotyledonous hosts (common clotbur, hemp, and wormwood), in the Kabardino-Balkar (vicinity of Nalchik) on maize and wild dicotyledonous hosts, and at the Ukraine (vicinity of Dnepropetrovsk and Odessa) on wild dicotyledonous hosts. Sorghum variety Kubanskoye krasnoye 1677 was infested with 2 egg masses (=40 eggs) per plant in the middle of whorl stage using 3 replicates and 5 plants per replicate. 20 days later leaf feeding injury was scored (Guthrie et al., 1960) as well as the number of alive larvae per plant dissected was analysed.

To assess the insect – host plant relations we conducted both natural infestation observations on sorghum fields compared with those of maize and an artificial infestation experiment on sorghum. Among plant genotypes used for observations and experiments grain sorghum was represented by the majority of varieties, namely Kubanskoye Krasnoye 1677, Efremovskoye 2, A 83, Yantar' krasnyi 271, and Yantar' Kubanskii. Entries of Sudan grass were few in number: NS, Kubanskaya 183, and Krasnoplenchataya 16/11. Variety Kubanskoye venichnoye was the only representative of broomcorn. Most of maize commercial hybrids were of local breeding (KOS 600, KOS 1089, TOSS 246, KUB 390), and of "Coop de Pau", France

(Nobilis, Alpis, Safaris, Axis, Memphis, Alton). Much more maize inbred lines used for observations were of local origin, namely K 101, K 102, K 111, K 123, K 205, K 395, K 407, K 430, K 347; other inbreds were represented by popular Russian and international genotypes (GK 28, K 611, F 2, F 5, 346, B73). In addition a few parental single crosses (Astra, Lirika, and Lira), one local variety (Urvanskoye beloye) and one popcorn variety (K 550) were used for observations.

In 1992-1993 we inspected the fields occupied by sorghum and maize in the case they grown adjacent each another. Egg masses per plant were counted once (1992) and twice (1993) a peak of oviposition during the 1st and 2nd generation using 5-20 randomised plots (each consisted of 25 plants) per field. 5-10 days after a completion of egg laying the percentage of plant attack was evaluated on the basis of leaf feeding incidence. For this purpose 100 plants (we chose 10 randomised plots each consisted of 10 plants) were observed on each field. 25-30 days later we made estimation of leaf feeding incidence once more. At the same time the number of larvae per plant was counted by dissecting of plants grown on 5-20 randomised plots each consisted of 5 plants.

During 1994-1999 we pursued an assessment of natural infestation of maize and sorghum fields in more detail as follows. Thus, we estimated total numbers of eggs laid both on sorghum and maize, by making a series of sequential counts on spatially fixed plots. Each egg mass found on foliage was marked and a hand lens was used to count the number of eggs as either hatched successfully, or dead due to parasitism, predation, dislodgement, failure to produce embryo, and larval inability to hatch. Each plot was examined for 6-8 times in 5-7 day intervals during a period of moth flight. To estimate the whole numbers of eggs laid as well as the 1st instar larvae hatched we summed up corresponding values found on a plot during successive observations. To raise comparability, both egg and larval densities on a crop were performed on the basis of m^2 because of sorghum plantings populated usually 2-3 times densely than those of maize. Unlike observations made in 1992-1993, we chose for observations fields of both crops even though they were nonadjacent each other.

Overall number of fields inspected was 13 for sorghum and 25 for maize. Periodical surveys of plants to search for eggs were done at 7-23 fixed plots (averaged in size 2.5 m^2) per field. After a week upon a completion of egg laying we sampled late instar larvae by dissecting plants grown at 10-50 randomised plots sized in average of 1.4 m^2.

To judge larval survival on sorghum an artificial experiment was carried out in 1992. Each plant (variety Kubanskoye krasnoye 1677) was infested in the middle of whorl stage with 2 egg masses (=40 eggs). 13-20 plants were dissected by 3, 12, 20, and 26 days after infestation and the number of alive larvae per plant was counted as well as places of larval feeding were recorded.

Larval survival according to whether the insect parents fed on maize or sorghum was estimated in 1990 and 1992 by using an artificial infestation experiment. Parental stocks were collected during autumn of the previous year. Sorghum variety Kubanskoye krasnoye 1677 was infested during the middle whorl stage of plant development. In 1990 we infested plants at the rate of 20 eggs per plant; plant dissections and counts of larvae were made 5 days later. In 1992 plants were infested with 40 eggs per plant and plant were dissected 40 days after infestation. In addition to the number of larvae we assessed score of leaf feeding damage after Guthrie et al. (1960).

RESULTS AND DISCUSSION

Both fed on sorghum and maize male adults possessed with midtibiae typical for *O. nubilalis* (in total 125 specimens collected during 1985-1998 were observed). However,

significant differences were found when they were compared to males of the hemp borer collected on dicotyledonous hosts.

An artificial infestation experiment evidenced that progenies of collected on maize insects survived on sorghum much better than those of collected on dicotyledonous hosts (table 1). The hemp borer from the North Caucasus as low survived on sorghum as the brush-legged borer or the ECB race kept its original trophic relations to dicotyledonous hosts.

Table 1. Leaf feeding scores and larval densities under artificial infestation of sorghum with egg masses produced by insects collected on maize or dicotyledonous host plants at different localities of the former USSR (KES, 1991)

Borer	Stock origin	Leaf feeding score	Number of larvae per plant
The ECB, *O. nubilalis*	The Krasnodar Territory, from maize	2.8	0.4
The ECB, *O. nubilalis*	Kabardino-Balkar, from maize	3.0	0.7
The hemp borer, *O. narynensis* Ч *nubilalis*	The Krasnodar Territory, from dicotyledonous hosts	1.8	0.1
The ECB, *O. nubilalis*	Kabardino-Balkar, from dicotyledonous hosts	1.8	0.2
The brush-legged borer, *O. scapulalis*	Dnepropetrovsk, from dicotyledonous hosts	1.6	0.1
The ECB, *O. nubilalis*	Odessa, from dicotyledonous hosts	1.8	0.1

All the mentioned above materials give rise to real suggestion that in the North Caucasus sorghum in couple with maize has infested by just the same population of the ECB specialised to rear on cereals.

Preliminary observations on natural infestation were conducted during 1992-1993 on fields where maize and sorghum grew in close vicinity to each other. On the whole, both overwintered and 1st generation adults attracted actively by sorghum plants to lay eggs on. Thus, densities of egg masses recorded during an oviposition peak as well as percentages of leaf feeding damage were almost equal in sorghum and maize (table 2, 3).

An artificial infestation experiment was used to estimate the rate of larval mortality on sorghum beginning with leaf whorl stage of plant development. The conclusion on rather high larval mortality on sorghum was confirmed: for the first 3 days after infestation larval death exceeded over 96%. At that time all the larvae were still developing at the 1st instar and fed on whorled leaves; most of infested plants carried one larva at least. Later, the number of larvae as well as percentage of infested plants decreased, most heavily during broom emergence in the middle of July when the insect mortality just exceeded over 50%. During this time larvae passed for the most part into leaf sheaths and central veins and a few penetrated into stalks (fig. 1).

The ECB larval feeding on maize has been studied carefully (e. g. Beck, 1987). Most larvae perish at the 1st instar for three initial days of their feeding, but later insect number gets stabilisation (e. g. Buske, Witkowski, 1985). Larvae at early instar need proteins especially; accordingly their feeding on tassel spikelets is favourable for insect survival. Since the 4th instar larvae are able to bore stalk for tunnelling, and during the 5th instar tunnels represent the place where larvae feed most often until pupation.

Table 2. Natural infestation and injury caused by the 1st generation of the ECB to near-by fields of maize and sorghum (KES, 1992-1993)

| Genotype	Field acreage, ha	Plants with leaves damaged, %	Number per plant		
			egg masses	holes	larvae
SORGHUM					
1992					
Kubanskoye Krasnoye 1677	8	65.4±0.05	–	–	0.05±0.04
Efremovskoye 2	35	71.0±6.40	–	0.05±0.02	0.02±0.01
Efremovskoye 2	20	71.0±4.92	–	0.03±0.02	0.10±0.03
1993					
A 83	0.5	59.0±7.8	0.36±0.09	0.04±0.04	0.12±0.05
Yantar' Kubanskii	0.3	46.0±12.1	0.17±0.04	0.02±0.02	0.08±0.04
Efremovskoye 2	5.0	43.0±9.8	0.20±0.04	0	0
Average		59.2	0.24	0.03	0.06
MAIZE					
1992					
K 101	0.4	34.0±7.50	–	1.75±1.98	0.54±0.78
F 2	9	79.0±4.30	–	2.24±0.32	0.94±0.67
K 550	5	18.8±2.47	–	0.12±0.03	0.08±0.03
1993					
K 101	0.5	73.0±5.0	0.66±0.12	1.92±0.50	0.48±0.17
F 2	0.8	60.0±9.0	0.38±0.06	1.88±0.37	0.48±0.15
B 73	1.5	18.0±3.9	0.14±0.10	0.40±0.13	0.37±0.11
KOS 600, KOS 1089, TOSS 246	45.5	56.0±9.3	0.16±0.04	0.50±0.21	0.28±0.08
KOS 1089	10.0	50.0±7.6	0.40±0.04	0.33±0.13	0.03±0.03
Average		48.6	0.34	1.14	0.40
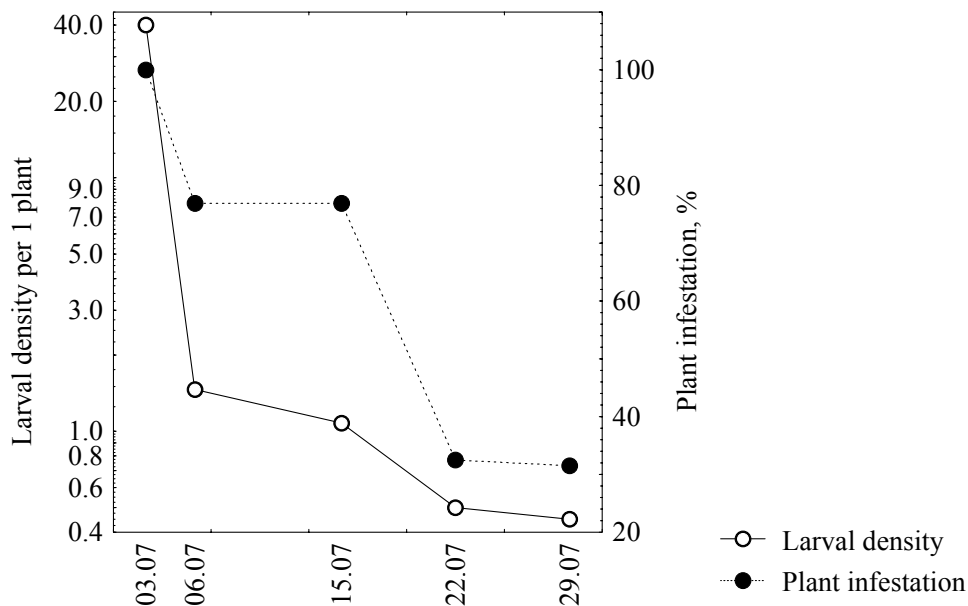
Figure 1. Dynamics of the ECB larval survival and plant infestation under an artificial infestation experiment on sorghum (KES, 1992)

Table 3. Natural infestation caused by the 2nd generation of the ECB to near-by fields of maize and sorghum (KES, 1992-1993).

Genotype	Field acreage, ha	Number of egg masses per plant
SORGHUM		
1992		
Kubanskoye Krasnoye 1677	8	0.80±0.13
Efremovskoye 2	35	0.10±0.02
Efremovskoye 2	20	0.31±0.06
1993		
A 83	0.5	0.09±0.07
Breeding entries	6.0	0.29±0.03
Yantar' Kubanskii	0.3	0.14±0.04
Efremovskoye 2	5.0	0.07±0.03
Efremovskoye 2 Ч Krasnoplenchataya 11/16	18.0	0.11±0.04
Efremovskoye 2	3.0	0.07±0.04
Krasnoplenchataya 16/11	2.0	0.06±0.02
Average		0.20
MAIZE		
1992		
K 101	0.4	0.43±0.08
F 2	9	0.05±0.01
K 550	5	0.36±0.08
1993		
K 101	0.5	0.11±0.02
Breeding entries	0.8	0.24±0.09
F 2	0.8	0.02±0.07
B 73	1.5	0.66±0.08
B73 Ч GK 28	5.0	0.28±0.07
GK 28	5.0	0.22±0.06
KOS 600	3.0	0.16±0.05
KOS 1089	10.0	0.36±0.09
Average		0.26

Thus, dynamics of larval mortality as well as feeding places on sorghum are quite different from those on maize.

Further attention was devoted to quantifying of larval survival on sorghum and maize under natural infestation. Having in mind this purpose, since 1994 we have been estimating total numbers of eggs laid both on sorghum and maize per 1 m^2 of sowing. Considerable variation in egg and larval numbers was shown between fields, years, and insect generations (table 4). Nevertheless, the averaged data evidenced that the mean density of 1st generation eggs laid on sorghum was 7.2 times less than it was on maize. The mean egg mortality on sorghum was rather less, perhaps, due to their lesser density. In accord, the 1st instar larval density on sorghum was 4.9 times as low as on maize. Since the average larval mortality for 1st-2nd instar was to a marked degree bigger on sorghum (96.6%) than on maize (91.4%), the mean larval density at late instar became 12.3 times greater on the latter host plant. As for the 2nd generation, the average level of egg mortality turned out to be somewhat higher on sorghum (70.1%) as compared to maize (56.6%). Despite rather slight difference in the 1st instar larval densities

between sorghum (23.3) and maize (37.0), the late instar larval density on the former host plant (1.14) was 13.4 times less than on the latter (15.32). The remarkable difference was originated from much more great larval mortality for early instar on sorghum (95.1%) opposite maize (58.7%).

Table 4. The estimation of the ECB larval survival on sorghum and maize under natural infestation (KES, 1994-1999).

Genotype	Field acreage, ha	Plant population, m^{-2}	Total insect density, m^{-2}					
			1st generation			2nd generation		
			eggs	larvae		eggs	larvae	
				I instar	III-V instar		I instar	III-V instar
SORGHUM								
1994								
Yantar' krasnyi 271	0.3	10.8	0.46	0.25	0.00	1.28	1.02	0.00
Efremovskoye 2	0.4	15.5	0.52	0.26	0.03	—	—	—
A83 Ч NS	1	13.9	0.36	0.21	0.01	20.87	5.21	0.00
A83 Ч NS	1	13.0	1.35	1.28	0.00	—	—	—
1995								
Kubanskoye krasnoye 1677	0.1	4.0	—	—	—	10.74	8.86	0.278
Kubanskaya 183	2	16.2	—	—	—	20.40	18.99	0.400
1996								
Kubanskoye venichnoye	4.2	15.3	9.39	9.39	0.33	49.37	34.92	2.68
Kubanskaya 183	2	25.6	3.70	3.70	0.00	—	—	—
Kubanskaya 183	5.5	216.1	16.89	16.89	0.96	—	—	—
1997								
Efremovskoye 2 Ч Krasnoplenchataya 16/11	15	15.8	51.06	36.07	0.93	280.43	35.93	3.93
1998								
Kubanskoye krasnoye 1677	0.02	6.3	0.91	0.64	0.00	164.60	73.65	1.19
1999								
Efremovskoye 2	0.4	4.6	1.40	1.22	0.18	76.19	7.85	0.65
Efremovskoye 2	4.5	8.5	3.18	1.19	0.00	—	—	—
Average			8.11	6.46	0.22	77.98	23.30	1.14
MAIZE								
1994								
K 407	0.5	5.0	18.33	6.34	0.50	4.55	2.76	0.85
K 611, K 102	0.5	4.6	12.41	4.46	0.30	8.86	4.88	1.52
346	1	4.9	8.75	2.33	0.22	2.91	2.27	2.15
Astra Ч K 101	18	5.1	24.84	15.63	1.85	1.94	1.31	0.84
TOSS 246	10	5.2	38.35	20.47	1.51	12.75	5.52	2.47
F 5	1	4.7	37.46	20.82	1.33	5.40	2.65	1.28

			1995					
K 430	0.5	4.6	—	—	—	8.50	6.24	4.12
K 407	1	2.8	—	—	—	6.21	4.21	2.84
K 611	0.3	4.2	—	—	—	3.39	1.58	1.00
(В73 Ч GK 28) Ч GK 28	1	2.9	—	—	—	3.95	3.26	1.54
			1996					
(В73 Ч GK 28) Ч GK 28	2	4.5	11.02	8.92	2.25	118.99	73.80	28.81
K 430 Ч K 347	1	5.1	6.23	5.48	0.59	193.45	127.88	62.23
K 430	2	4.4	3.68	2.60	0.85	115.69	82.54	49.02
Lirika Ч F 5	1	4.2	14.63	8.06	1.54	110.57	68.14	30.83
			1997					
K 123, K 395	1	4.3	96.80	53.24	0.19	79.55	39.17	12.00
K 111, K 611	1	4.4	30.56	19.54	0.11	168.72	56.71	14.07
Nobilis, Alpis, Safaris, Axis, Memphis, Alton	4	5.7	82.77	63.10	0.24	123.78	55.88	27.67
			1998					
Urvanskoye beloye	2	5.0	189.41	107.43	7.79	284.25	91.07	20.63
Lira Ч K 205	20	3.6	89.25	39.44	2.57	190.08	50.23	11.96
K 395	2	7.3	228.64	75.24	16.39	47.58	19.17	11.00
TOSS 246	22	5.1	—	—	—	139.73	46.90	17.04
			1999					
Lirika Ч F 5	18	4.8	13.29	9.13	0.43	132.30	48.26	19.57
KUB 390	3	5.8	18.98	9.62	1.43	—	—	—
В 73 Ч GK 28	2	5.6	82.26	49.18	5.29	—	—	—
K 611	1	4.9	167.03	113.68	9.29	201.97	57.70	28.80
Average			58.74	31.74	2.73	85.44	37.05	15.32

Sorghum becomes to attract overwintered moths for egg laying significantly later when compared to maize. It is quite appropriate to explain the low numbers of 1st generation eggs laid on sorghum with two reasons as follows. First, sorghum is sowed usually 15-20 days later than maize, and second, an initial growth of sorghum seedlings is rather slow. However, temporal differences in egg laying on maize and sorghum completely disappear until flying of the 1st generation adults. The results obtained in 1997 are given as an illustration of egg laying dynamics on sorghum and maize (fig. 2).

The specificity in ovipositional terms of overwintered females is not a unique reason for necessity of comparing infestation levels of sorghum and maize on the basis of counting of total egg numbers. It is variation in average size of egg masses laid on different crops that represents another factor of indignation.

It is well actually known that the ECB moths lay their eggs grouping into clusters which vary in size from 1 to 180 and more eggs per one mass (Shchegolev, 1934; Caffrey, Worthley, 1927; Hudon, LeRoux, 1986, and so on). Curiously different estimates of mean size of egg masses were reported, e. g. 10-25 eggs (Khomyakova, 1962), 12-32 (Andreeva, 1930), 15-20 (Caffrey, Worthley, 1927).

During an examination of plants in 1993-1999 we found totally 30715 egg masses on maize and 1118 on sorghum. The average number of eggs per mass depends to a great extent on

a host plant species (more often larger masses were recorded on sorghum) as well as a generation (the 2nd generation masses were much bigger when laid on both maize and sorghum) (fig. 3).
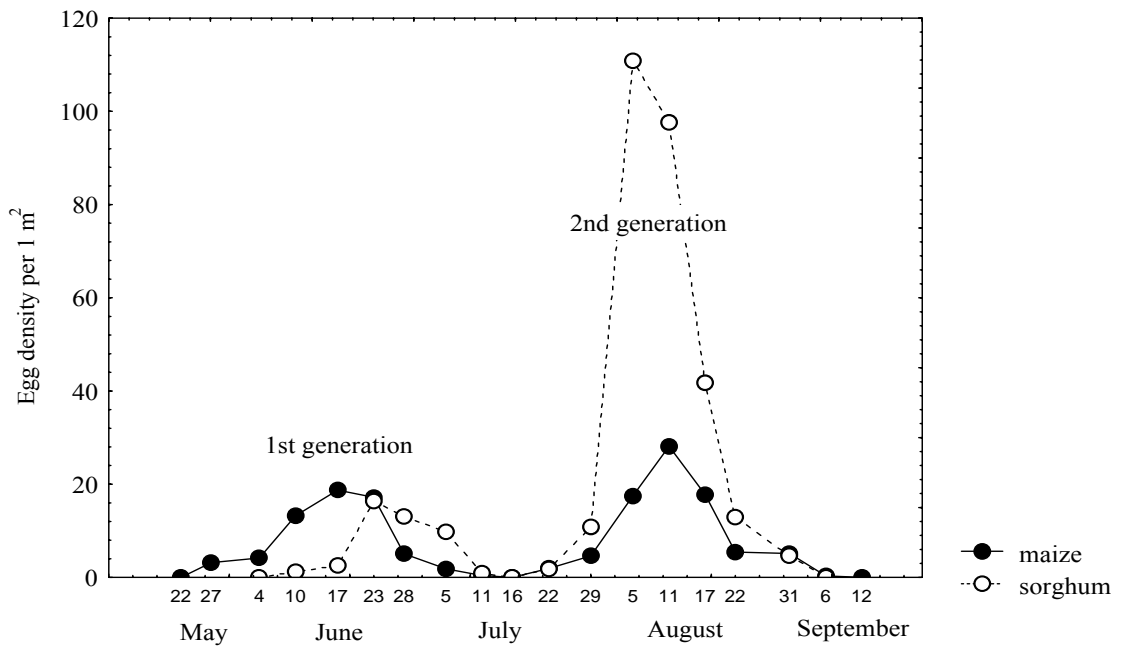

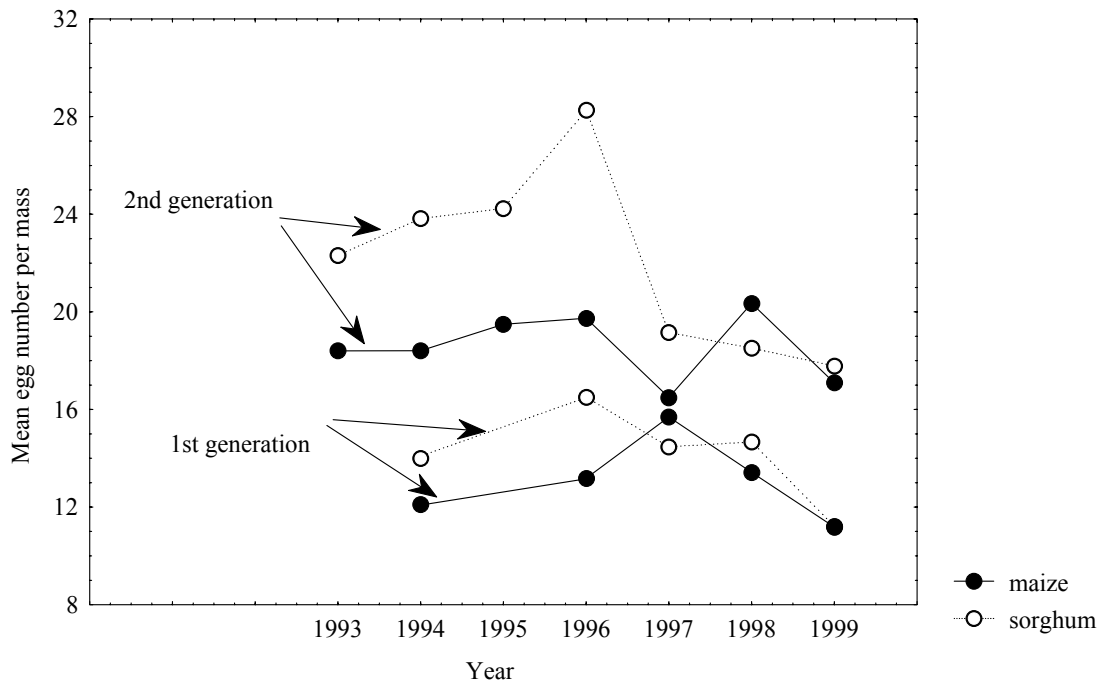Figure 2. Ovipositional dynamics for the 1st and 2nd generations of the ECB on maize and sorghum (KES, 1997)

Figure 3. Average numbers of eggs per mass laid on sorghum and maize during the 1st and 2nd generations of the ECB (KES, 1993-1999).

Therefore, the ECB inhabitancy on sorghum is rather specific in many respects. The most curious peculiarity is a conflict combination of low larval survival along with a high attractiveness to adults for egg laying. It seems to be interesting from an evolutionary point of

view. On the one hand, a selection should act against the moths if their offspring is not adapted to sorghum feeding. On the other, if some adaptive features to larval feeding on sorghum occurred, they would catch up due to a selection. One can imagine that such a combination may provoke somewhat like a disruptive selection when the insect has a choice to exploit either sorghum or maize. If so a selection would segregate a population onto specifically adapted to maize and sorghum subpopulations.

Some data obtained after an artificial infestation experiment (table 5) indicated that the formation of host race specialised on sorghum could realise in the ECB under certain conditions. Nevertheless, some obstacles prevent such a process. In particular, larval growth on sorghum is rather slow during the 1st generation as opposed to maize. Actually, during the end of July – the early of August most of insects of the 1st generation fed on sorghum still remain at the larval stage and only a small part of them start pupation. By contrast, at that time most insects fed on maize represent ovipositing adults. As a rule the dates of egg laying on maize and sorghum are coincident during the 2nd generation. So, renewal of sorghum population occurs to a maximum each year from eggs laid by insects reared on maize. Another obstacle, preventing a formation of sorghum specialised race, could be very late happening of developmental stages in sorghum suitable for egg laying by overwintered adults.

Table 5. Survival of the ECB larvae on sorghum under an artificial infestation depending on a host plant of insect ancestors (KES, 1990, 1992).

Insect stock originated from	Leaf feeding score	Larval density per 1 plant
	1990	
Maize	6.1	4.4
Sorghum	6.2	5.9
	1992	
Maize	2.6	0.07
Sorghum	3.7	0.67

Although dicotyledonous plants of the European origin such as hop and mugwort were most probably the initial hosts for the ECB, at present cereals are infested more often and much intensive. Among them common millet, *Panicum miliaceum*, and Italian millet, *Setaria italica*, are certain to be the most ancient cereals which had spread wide over Asia and Europe even in neolite (Lysov, 1968). Sorghum is considered the plant of African origin and it was introduced into the European agriculture much more recently, approximately in 700-400 B. C. (Doggett, 1970). The Europeans had never been familiar to maize until Columbus discovered the Americas as recently as about 500 years ago; besides, the crop occupied considerable acreage towards the 17th century only (Dekaprelevich, 1960). Despite much more extended period of coexistence with sorghum the ECB manifests much less fitness when feeding on this plant contrary to maize.

In fact, the data obtained agree nicely with published materials indicated of worse rearing conditions for larvae and consequently their higher mortality when feeding on sorghum. As a rule, full-grown larvae are sparsely distributed on sorghum, even though very high numbers of eggs laid on the crop. In other words, borer adults can choose sorghum for egg laying very actively, in spite of low feeding quality of the plant for their offspring.

The search, choice, and determination of host availability by an insect for egg laying are very complicated processes specific for different species. From an evolutionary point of view ovipositing behaviour is aimed to make as good as possible compromise between risk spreading (e.g. Root, Kareiva, 1984), making choice for better host for posterity (e.g. Papaj, Rausher, 1987), providing optimal density for offspring over hosts (e.g. Schoonhoven et al., 1990), and realising maternal fecundity to a maximum. More often (Tabashnik et al., 1981; Scriber, Dowell,

1991, etc.), but not necessarily (Dethier, 1959; Courtney, 1981, etc.) females prefer for egg laying to those hosts which are the most appropriate for offspring development. Despite of distinction of criteria used by adults and larvae for host acceptation as exemplified by a specificity of genetic background (Thompsen et al., 1990), one could very often determine significant covariation between a choice of host plant for oviposition by adults and its suitability for feeding by larvae (e.g. Via, 1986). Suboptimal and even inappropriate ovipositing on a host plant by an adult resulted in poor feeding by offspring (e.g. Ehman, 1986) can be traced to a number of reasons (Chew, 1977); violating the principle of optimality in host plant preferences by ovipositing adult (Kreslavsky-Smirnov, 1987) is readily apparent from the predicting essence of estimation of host availability for offspring in the future.

As a rule, one determines preferred host plant species for herbivorous insect on the basis of larval attack. However, it is of no less value also to test host plant preferences on the basis of egg laying as it follows from the data presented above.

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