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Differential suitability of sugar beet cultivars for the beet armyworm (*Spodoptera exigua*): Insights from life-table analysis

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ABSTRACT

The beet armyworm, ***Spodoptera exigua*** (Hübner) (Lepidoptera: Noctuidae), is a major pest of sugar beet (*Beta **vulgaris*** L.) worldwide, causing substantial quantitative and qualitative yield losses. In this study, we examined the life history and demographic parameters **of *S. exigua*** on four commercial sugar beet cultivars ('Arta', 'Karta', 'Nika', and 'Rubina') under controlled laboratory **conditions.** Population parameters were estimated using the age-stage, two-sex life table approach. The egg incubation period did not differ significantly among cultivars (approximately 2.00 days; $P > 0.05$). **However, the total preadult developmental time (egg to adult emergence) differed significantly among cultivars and was shortest on 'Karta' and longest on 'Arta'**. Fecundity varied markedly among cultivars, reaching its highest value on 'Arta' (382.97 eggs/female) and lowest on 'Nika' (132.37 eggs/female). A similar pattern was observed for key demographic parameters: the net reproductive rate (R_0) ranges from 56.72 offspring/individual on 'Nika' to 169.67 offspring/individual on 'Arta'. The intrinsic rate of increase (r) varied significantly among cultivars, ranging from 0.152 day^{-1} on 'Nika' to 0.209 day^{-1} on 'Arta'. Taken together, these results suggest that cultivar 'Nika' is less suitable for population growth of *S. exigua* under laboratory conditions, whereas 'Arta' appears more favorable. Slower population growth on cultivars such as 'Nika' may contribute to reduced pest pressure, although this would need to be confirmed under field conditions. Accordingly, 'Nika' could be considered a potentially useful component within IPM programs, rather than a fully resistant cultivar per se.

KEYWORDS: *Beta vulgaris*, Demographic parameters, Host plant resistance, Pest management, Population growth, *Spodoptera exigua*.

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Introduction

Sugar beet (*Beta vulgaris* L.) is the world's second most important sucrose-producing crop after sugarcane, accounting for approximately 30–40% of global sugar output (Qi, 2022). Beyond sugar production, it serves as a vital raw material for bioethanol, animal feed (pulp), pectin, and various food industries (Rastogi and Shukla, 2022). Over the past decades, genetic improvements and optimized agronomic practices have substantially increased sugar beet yields, with modern cultivars showing strong adaptability to diverse environmental conditions. Iran ranks as the second-largest sugar beet producer in the Middle East after Turkey, with an annual production exceeding 5 million tons (USDA-ERS, 2024).

Sugar beet production in Iran, like in other regions worldwide, faces considerable challenges from insect pests (Golizadeh et al. 2016). **Among these, the beet armyworm, *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae), is a major polyphagous pest that causes substantial quantitative and qualitative damage to sugar beet foliage through leaf consumption, resulting in defoliation, reduction of photosynthetic area, and deterioration of leaf quality.** During severe outbreaks, larvae may also penetrate the crown and roots (Golizadeh et al. 2016). This highly polyphagous species feeds on more than 170 plant species across 35 families in 152 countries (CABI, 2021). In California, *S. exigua* has become the most important insect pest of sugar beet, surpassing aphids and causing increasing late-season defoliation (Haviland and Godfrey, 2001). Similarly, in the Middle East and Turkey, the beet armyworm is recognized as a serious seasonal threat that can cause significant economic losses during outbreak years (Sunulu et al. 2020).

Host plant resistance provides an environmentally sound and sustainable approach for managing *S. exigua* by suppressing pest development, reducing population growth, and decreasing reliance on chemical insecticides (Zehnder et al. 2007; Islam et al. 2017b). The deployment of resistant or less suitable cultivars is a fundamental component of integrated pest management (IPM) programs for sustainable sugar beet production (Özgokce et al. 2006). Accurate assessment of pest fitness across different host plants requires detailed life table analysis that integrates key demographic parameters, including survival rate, development, and reproduction (Islam et al. 2017a). Among these parameters, the intrinsic rate of increase (r) is particularly useful for evaluating host plant suitability and designing effective IPM strategies (Birch, 1948).

The age-stage, two-sex life table approach offers a comprehensive framework by incorporating stage differentiation and analyzing both sexes simultaneously. This method has become the preferred tool in demographic studies because it provides the most accurate and detailed information on population structure, survival, development, and reproductive potential (Chi et al. 2020, 2022, 2023). **Although the performance of *S. exigua* on various sugar beet cultivars has been studied under laboratory and field conditions (Karimi-Malati et al. 2012; Mehrkhou, 2015; Golizadeh et al. 2016; Talaee et al. 2016), none of these studies included the four newly released commercial cultivars evaluated in the present work ('Arta', 'Karta', 'Nika', and 'Rubina'). These cultivars have recently been introduced into commercial sugar beet production in Iran. To the best of our knowledge, no published study has evaluated their suitability for *S. exigua* using the age-stage, two-sex life table approach. Such information is essential for identifying cultivars with lower suitability to the pest and for integrating host plant resistance into sustainable IPM programs. Therefore, the present study was conducted to fill this knowledge gap by providing the first comparative assessment of the life history and population growth of *S. exigua* on these four commercially important cultivars under controlled laboratory conditions. The findings provide valuable baseline information for cultivar selection and sustainable pest management in sugar beet production.**

Materials and Methods

Plant materials and sugar beet cultivars

The experiment was conducted during the 2025–2026 growing season at the Agricultural Research Station of West Azerbaijan Province, Iran. Four sugar beet cultivars, namely 'Arta', 'Karta', 'Nika', and 'Rubina', were evaluated. 'Arta', 'Nika', and 'Rubina' were provided by Daneshmandān-e Giyāhān-e Zarrin Knowledge-Based Company, whereas 'Karta' was provided by Helizog Company (Sweden). Cultivar selection was based on their agronomic importance and cultivated area, representing the most widely grown sugar beet cultivars in the region. The cultivars were grown under field conditions using a randomized complete block design with four replicates. All cultivars received the same agronomic management practices, including regular irrigation throughout the growing season. No insecticides were applied during cultivation. Healthy, fully expanded leaves were collected from field-grown plants and used in laboratory bioassays.

Insect Culture

Larvae of ***S. exigua*** were collected from an infested sugar beet field in Miandoab (West Azerbaijan, Iran) in 2025. **The larvae were divided into four groups, and each group was reared for two generations on one of the four sugar beet cultivars ('Arta', 'Karta', 'Nika', or 'Rubina') to acclimatize the insects to each host plant and to minimize any potential maternal or carry-over effects from the previous host. Larvae were maintained individually in plastic containers (7 × 10 × 3 cm) covered with fine mesh cloth. Fresh leaves of the respective sugar beet cultivars were collected daily from the experimental field and provided to the larvae as food. Leaves were replaced every 24 h throughout the experiment to ensure a continuous supply of fresh plant material. The same leaf collection and replacement procedure was applied consistently to all cultivars. Pupae and adults were kept in transparent plastic containers (12 cm diameter × 8 cm height). Adults were fed with cotton balls soaked in a 10% honey solution during the oviposition period (Golizadeh et al., 2016). For the life table study, newly emerged adults were paired in cages for oviposition. Seventy eggs laid within 24 h were collected and maintained individually (Chi et al., 2020).**

Development and fecundity

Seventy same-age eggs (24-h-old) were collected from each cultivar and placed individually on sugar beet leaves inside Petri dishes. Developmental stages were recorded every 24 hours. The experiment was conducted under controlled laboratory conditions at 26 ± 1°C, 50–60% relative humidity, and a photoperiod of 16:8 h (L:D). Newly emerged adult females and males were paired and kept in rearing containers until the females died. **Adult sex was determined immediately after emergence by examining the external morphology of the terminal abdominal segments under a stereomicroscope. Males and females were distinguished based on the characteristics of the abdominal tip prior to pairing**. Biological characteristics, fecundity, survival rate, generation time, and daily mortality were recorded. The experiment continued until the last **adult** died.

Data Analysis

The life-history raw data of all individuals were analyzed using the age-stage, two-sex life table (Chi 1988; Chi and Liu 1985). The life table parameters including the age-stage specific survival

rate (s_{xj}) (where x = age in days and j = stage); the age-stage-specific fecundity (f_x) (daily number of eggs produced per female of age x); the age-specific survival rate (l_x); the age specific fecundity (m_x), adult preoviposition period (APOP, the preoviposition period counted from the adult emergence), total **preoviposition** period (TPOP, the preoviposition period counted from birth) and the population growth parameters, the net reproductive rate (R_0), mean generation time (T), and intrinsic rate of increase (r) were calculated **accordingly**.

The standard errors of the developmental times, fecundity, reproduction period and population parameters were estimated by using the bootstrap method (Efron and Tibshirani, 1993; Huang and Chi, 2012), with 100,000 bootstraps to obtain stable estimates of standard errors (Akca et al. 2015). The paired bootstrap test was used to compare differences (Efron and Tibshirani, 1993). The computer program TWOSEX-MSChart (Chi, 2024) was used for raw data analysis and for calculating population parameters. **All figures were plotted using Sigmaplot 15 software.**

Results

Developmental and survival

S. exigua successfully developed on all four sugar beet cultivars (Table 1). No significant differences were detected in egg incubation period among cultivars (**2.00 d**; $P > 0.05$), nor in female **life span,** which remained relatively stable across treatments (30.67–31.58 d). In contrast, several larval stages showed cultivar-dependent variation. The **first larval instar** was the longest on 'Rubina' (1.70 d) and the shortest on 'Nika' (1.19 d; $P < 0.05$). The **third larval instar** was significantly longer on 'Nika' (3.77 d) than on 'Arta' (1.75 d; $P < 0.05$). When considering the preadult period as a whole, development was slightly shorter on 'Arta' and longer on 'Karta' and **'Nika'**. Female adult longevity varied significantly, ranging from 10.83 d on 'Rubina' to 12.77 d on 'Arta' ($P < 0.05$; Table 1).

Female adult preoviposition period (APOP) differed significantly among cultivars, ranging from 2.86 d on 'Arta' (shortest) to 4.09 d on 'Nika' (Table 1). A similar trend was observed for TPOP, which was shortest on 'Arta' (21.54 ± 0.45 d) and longest on 'Nika' (24.43 d), indicating earlier reproductive onset on 'Arta'. Fecundity showed strong cultivar-dependent variation. The highest fecundity was recorded for 'Arta' (382.97 offspring/female), followed by 'Rubina' (234.93) and 'Karta' (215.97), while the lowest value was observed for 'Nika'

(132.37) ($P < 0.05$). The oviposition period was also significantly longer on 'Arta' (5.68 d) than in other cultivars (3.25–3.87 d).

The age-stage survival curves (s_{xj}) revealed considerable overlap among developmental stages (Figure 1), indicating variability in individual development rates across cultivars. This pattern was consistent with the differences observed in stage-specific durations.

Population growth parameters

Life table parameters further highlighted differences in host suitability among cultivars (Table 2). The net reproductive rate (R_0) was highest on 'Arta' (169.67 offspring/individual) and lowest on 'Nika' (56.72 offspring/individual; $P < 0.05$). A consistent pattern was observed for the intrinsic rate of increase (r), which ranged from 0.**1524** day^{-1} on 'Nika' to 0.**2091** day^{-1} on 'Arta'.

The mean generation time (T) showed an opposite tendency, being shorter on 'Arta' (24.53 d) and longer on 'Nika' (26.48 d; $P < 0.05$). Taken together, these parameters suggest more favorable population growth conditions on 'Arta', whereas population increase was comparatively slower on 'Nika'.

The age-specific survival (l_x), fecundity (m_x), and maternity ($l_x m_x$) curves (Figure 2) further illustrated the demographic differences among the four sugar beet cultivars. Although the survival curves showed relatively similar patterns among cultivars, females reared on 'Arta' exhibited earlier and higher peaks of age-specific fecundity and maternity, indicating earlier reproductive maturation and greater reproductive output. In contrast, the delayed and lower peaks observed on 'Nika' reflected reduced reproductive performance and slower population growth. Similarly, the age-stage reproductive value (v_{xj}) reached higher values and peaked earlier on 'Arta', whereas it was lower and peaked later on 'Nika' (Figure 3). The life expectancy (e_{xj}) curves (Figure 4) showed that individuals reared on 'Arta' generally maintained a longer expected lifespan during the reproductive period than those reared on 'Nika'. These demographic patterns collectively confirm that 'Arta' provides more favorable conditions for population increase, whereas 'Nika' is comparatively less suitable for the development and reproduction of *S. exigua*.

Discussion

Although the beet armyworm, ***S. exigua*****, is** widely recognized as a major pest of sugar beet worldwide (Capinera, 2001; **Sunulu et al. 2020),** detailed demographic comparisons among commercial cultivars remain relatively scarce (Golizadeh et al. 2016). **The present study provides new demographic information on four recently introduced commercial sugar beet cultivars and contributes to a better understanding of host suitability for *S. exigua*.** Life table parameters are commonly used to assess population growth potential under specific host conditions **(Islam et al. 2017a), yet** their interpretation is often more informative when differences are considered collectively rather than trait by trait.

The egg incubation period remained stable across cultivars, which is perhaps not surprising, as early embryonic development in many Lepidoptera is generally less sensitive to host plant variation (Karimi-Malati et al. 2012; Mehrkhou 2015; Golizadeh et al. 2016). In contrast, the larval stages appeared more responsive to host differences, which is where nutritional and defensive plant traits are more likely to exert their effects. The prolonged **third larval instar** on 'Nika', for instance, may suggest some degree of suboptimal feeding or metabolic adjustment, whereas shorter development on 'Arta' is consistent with a more favorable host. Similar patterns have been reported elsewhere (Golizadeh et al. 2016; Talaee et al. 2016; Mehrkhou, 2015), reinforcing the idea that larval performance is a sensitive indicator of host suitability. **Differences in preadult developmental time among studies may partly arise from methodological approaches, such as the use of whole leaves versus leaf discs, which can influence feeding conditions and insect performance by varying in food uniformity and leaf structure.**

It is worth noting, however, that differences in preadult development time were relatively small in absolute terms. This raises the possibility that methodological aspects—such as the use of whole leaves rather than leaf discs—may have influenced developmental outcomes, as previously observed for other herbivores (Kavousi et al. 2009). **Although methodological differences among studies may influence developmental estimates, the observed differences among cultivars were obtained under identical experimental conditions and therefore provide a reliable comparison of their relative suitability.**

Reproductive output showed clearer differentiation among cultivars. Fecundity was markedly higher on 'Arta' and substantially reduced on 'Nika', a contrast that likely drives much of the divergence observed in population growth parameters. **While such differences are generally**

associated with variation in host plant quality, previous studies on *S. exigua* feeding on different sugar beet cultivars have likewise shown that cultivars supporting higher fecundity and faster population growth are characterized by greater host suitability, whereas less suitable cultivars are associated with reduced reproductive performance (Karimi-Malati et al. 2012; Mehrkhou, 2015; Golizadeh et al. 2016). The shorter pre-oviposition periods and extended oviposition activity on 'Arta' further support the idea of a more favorable nutritional or chemical environment.

That said, fecundity estimates in laboratory studies should be interpreted with some caution. They are sensitive to rearing conditions, mating success, and even handling procedures, which may partly explain discrepancies with earlier reports (Mehrkhou, 2015; Talaee et al. 2016). **Although absolute values may vary across studies due to differences in experimental conditions, the relative differences among cultivars observed in the present study provide a reliable basis for comparing host suitability.**

The shorter APOP and TPOP observed on 'Arta' indicate an earlier onset of reproduction compared with the other cultivars, whereas delayed pre-oviposition on 'Nika' reflects a slower transition from immature stages to reproductive activity (Table 1). This reduction in the pre-reproductive period on 'Arta' is particularly important, as earlier reproduction generally contributes to higher intrinsic rates of increase (*r*) by allowing individuals to produce offspring sooner and extend their effective reproductive period. In contrast, prolonged APOP and TPOP on 'Nika' may partly explain its lower fecundity and reduced population growth potential. Earlier reproduction and higher fecundity observed on 'Arta' are consistent with its higher intrinsic rate of increase (*r*) and net reproductive rate (R_0), indicating superior host suitability for *S. exigua*. Similar relationships between shortened pre-oviposition periods, increased fecundity, and enhanced population growth have been reported in previous studies on sugar beet cultivars (e.g., Karimi-Malati et al. 2012; Mehrkhou, 2015; Golizadeh et al. 2016). In contrast, the delayed reproductive schedule and reduced fecundity on 'Nika' correspond well with its lower demographic performance, confirming cultivar-dependent variation in host suitability.

The intrinsic rate of increase (*r*) is widely regarded as the most informative demographic parameter for evaluating host plant suitability because it integrates the combined effects of survival, developmental rate, and fecundity into a single estimate of population growth

potential (Birch, 1948). Consequently, even relatively small differences in *r* may result in substantial differences in population growth over successive generations. In the present study, *r* ranged from 0.152 day^{-1} on 'Nika' to 0.209 day^{-1} on 'Arta', indicating considerable variation in the demographic performance of *S. exigua* among the tested cultivars. These values are broadly consistent with those reported in previous studies on sugar beet cultivars (Karimi-Malati et al. 2012; Mehrkhou 2015; Golizadeh et al. 2016), although direct comparisons should be made with caution due to differences in cultivars, environmental conditions, and experimental methodologies. The lower values of both *r* and net reproductive rate (R_0) observed on 'Nika' indicate that this cultivar supported slower population growth and reduced reproductive output compared with the other cultivars tested. Since R_0 reflects the average number of offspring produced by an individual during its lifetime, while *r* describes the overall capacity of a population to increase, the consistent reduction in both parameters suggests that 'Nika' was the least suitable host for *S. exigua* under the present laboratory conditions. Similar conclusions have also been reported in previous demographic studies of *S. exigua* on sugar beet, where cultivars associated with lower values of *r* and R_0 were considered less suitable hosts (Karimi-Malati et al. 2012; Mehrkhou, 2015; Golizadeh et al. 2016). Nevertheless, these results should be interpreted as evidence of relative host suitability rather than as definitive evidence of host plant resistance under field conditions. The observed differences among cultivars may be associated with variation in their nutritional quality, secondary metabolites, and morphological characteristics. Previous studies have shown that compounds such as phenolics and saponins, together with differences in leaf nutritional composition and surface traits (e.g., trichome density, epicuticular wax, and leaf toughness), can influence herbivore feeding, development, survival, and reproduction (van den Boom et al. 2003; Hoy, 2011; Talaee et al. 2016). Although these plant characteristics were not directly evaluated in the present study, they represent plausible mechanisms underlying the demographic differences observed among cultivars. Future studies integrating life table analysis with biochemical and morphological characterization of sugar beet cultivars would provide a more mechanistic understanding of host suitability and facilitate the development of resistant cultivars for IPM programs.

From an applied perspective, lower population growth on 'Nika' could be advantageous within an IPM framework, particularly if it translates into delayed population buildup in the field. At the

same time, laboratory-based life table studies tend to oversimplify ecological complexity, and factors such as natural enemies, environmental variability, and plant phenology may substantially alter these dynamics (Liu et al. 2004).

Taken together, the results suggest that 'Nika' is less favorable for *S. exigua* development and reproduction than the other cultivars tested, **although its suitability for *S. exigua* was lower than that of the other cultivars.** Its use in pest management programs may therefore be justified, not as a standalone solution, but as one component within a broader, integrated strategy.

Conclusion

This study evaluated the demographic performance of the beet armyworm, ***S. exigua*,** on four commercial sugar beet cultivars using the age-stage, two-sex life table approach. Among the cultivars tested, 'Nika' exhibited the lowest host suitability, as evidenced by reduced fecundity, slightly prolonged development, and a lower intrinsic rate of increase (r), whereas 'Arta' supported the highest population growth. Although these differences were observed under laboratory conditions and do not indicate strong host plant resistance, the results suggest that 'Nika' may be a useful component in integrated pest management programs, potentially reducing reliance on chemical control. Further field studies integrating plant nutritional, biochemical, and morphological traits are needed to validate these findings and clarify the mechanisms underlying host suitability.

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Table 1. Developmental, longevity, and reproductive parameters (mean ± SE) of *Spodoptera exigua* reared on four sugar beet cultivars.

Stages	Cultivars							
	Nika		Rubina		Karta		Arta	
	n	Mean ± SE	*n*	Mean ± SE	*n*	Mean ± SE	*n*	Mean ± SE
Egg	70	2.00 ± 0.00 a	70	2.00 ± 0.00 a	70	2.00 ± 0.00 a	70	2.00 ± 0.00 a
L1	70	1.19 ± 0.11 c	69	1.70 ± 0.09 a	68	1.46 ± 0.08 b	70	1.29 ± 0.07 cb
L2	65	3.12 ± 0.20 a	68	2.71 ± 0.17 ba	68	2.62 ± 0.16 cb	70	3.07 ± 0.12 a
L3	62	3.77 ± 0.16 a	61	3.10 ± 0.16 b	68	2.69 ± 0.18 b	69	1.75 ± 0.12 c
L4	50	2.88 ± 0.22 a	56	2.29 ± 0.19 b	68	3.18 ± 0.20 a	67	2.91 ± 0.18 a
L5	35	2.34 ± 0.19 a	43	3.00 ± 0.19 b	58	3.07 ± 0.22 b	59	2.85 ± 0.21 ab
Pupa	35	5.23 ± 0.25 b	42	6.26 ± 0.19 a	56	5.52 ± 0.23 b	56	5.30 ± 0.18 b
Adult	35	11.89 ± 0.68 ab	42	11.45 ± 0.48 a	56	11.43 ± 0.67 ab	56	12.96 ± 0.51 b
Female preadult	30	19.83 ± 0.45 ab	30	19.83 ± 0.29 a	36	20.08 ± 0.37 a	31	18.81 ± 0.31 b
Male preadult	5	20.80 ± 0.73 a	12	20.25 ± 0.49 a	20	20.45 ± 0.45 a	25	19.00 ± 0.33 b
Female adult longevity	30	11.47 ± 0.76 ab	30	10.83 ± 0.57 b	36	11.31 ± 0.83 ab	31	12.77 ± 0.76 a
Male adult longevity	5	14.40 ± 0.75 a	12	13.00 ± 0.79 ab	20	11.65 ± 1.17 b	25	13.20 ± 0.63 ab
Female life span	30	31.30 ± 0.87 a	30	30.67 ± 0.55 a	36	31.39 ± 0.74 a	31	31.58 ± 0.80 a
Male life span	5	35.2 ± 1.16 a	12	33.25 ± 0.99 ab	20	32.10 ± 1.08 b	25	32.20 ± 0.70 ab
APOP	23	4.09 ± 0.40 a	30	4.07 ± 0.42 a	32	3.53 ± 0.31 ab	28	2.86 ± 0.33 b
TPOP	25	24.43 ± 0.64 a	30	23.90 ± 0.53 a	32	23.44 ± 0.35 a	28	21.54 ± 0.45 b
Fecundity (*F*)	23	132.37 ± 18.53 c	30	234.93 ± 16.37 b	36	215.97 ± 23.56 b	31	382.97 ± 38.30 a
Oviposition days	23	3.87 ± 0.33 b	30	3.87 ± 0.22 b	32	3.25 ± 0.29 b	28	5.68 ± 0.47 a

Standard errors (SE) were estimated using the bootstrap technique with 100,000 resampling. Means within a row followed by the same lowercase letter are not significantly different among sugar beet cultivars according to the paired bootstrap test ($P < 0.05$).

Table 2. Life table parameters (mean ± S.E.) of *Spodoptera exigua* Hubner (male and female) on different sugar beet cultivars.

Parameter	Cultivars			
	Nika	Rubina	Karta	Arta
R_0 (offspring/individual)	56.72 ± 11.05 c	100.68 ± 15.48 b	111.07 ± 17.55 ba	169.67 ± 28.18 a
r (day^{-1})	0.1524 ± 0.008 c	0.1800 ± 0.007 b	0.1845 ± 0.006 b	0.2091 ± 0.007 a
λ (day^{-1})	1.164 ± 0.010 c	1.197 ± 0.008 b	1.202 ± 0.008 b	1.232 ± 0.009 a
T (day)	26.48 ± 0.51 a	25.61 ± 0.44 b	25.52 ± 0.32 b	24.53 ± 0.50 c

***R*₀, net reproductive rate; *r*, intrinsic rate of increase; *λ*, finite rate of increase; *T*, mean generation time. Standard errors were estimated by using the bootstrap technique with 100,000 resampling. Means followed by the same letter in a row indicate no significant difference between cultivars (paired bootstrap test, *P* < *0.05*).**

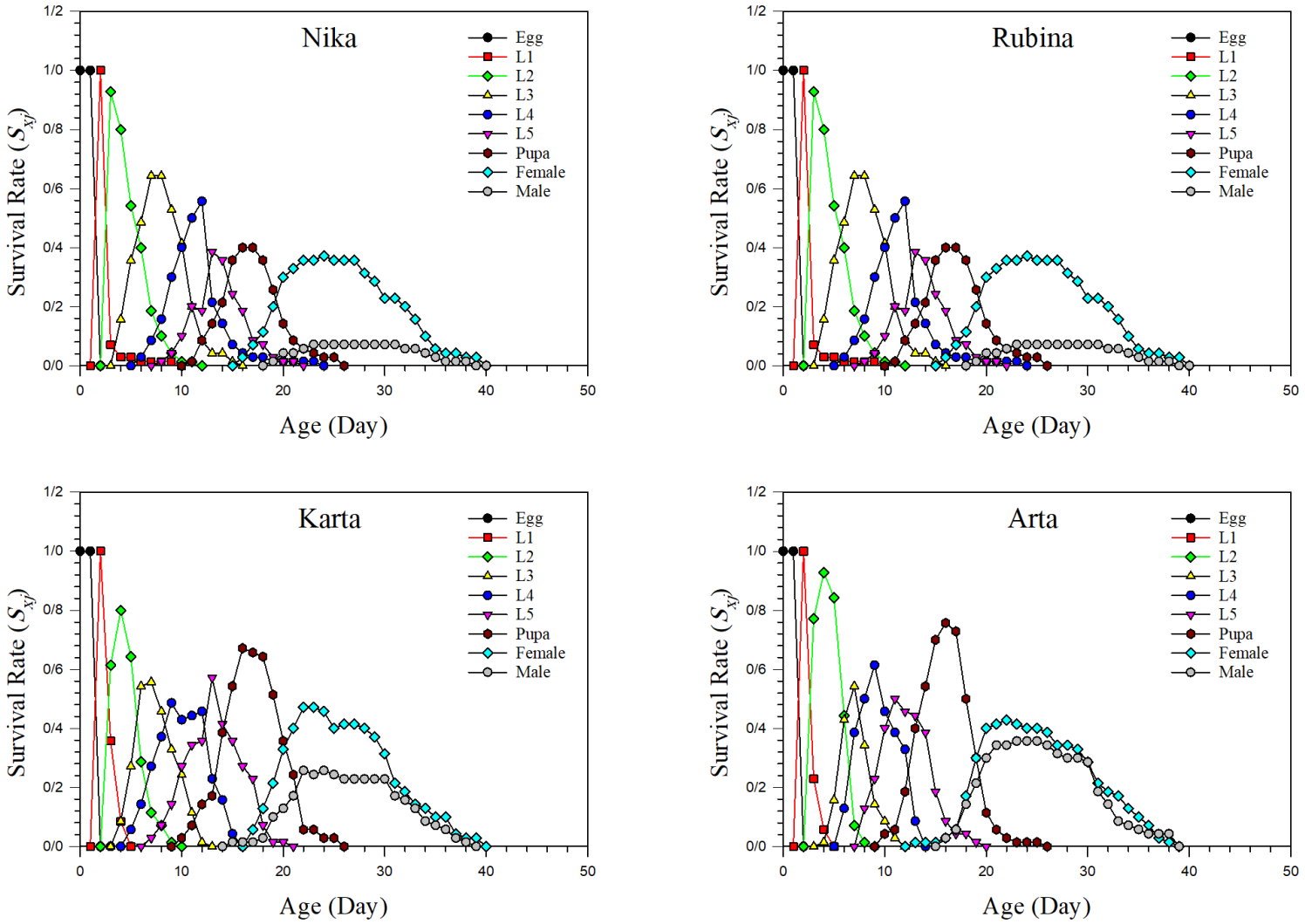


Figure 1. Age-specific survival rate (S_{xj}) of *Spodoptera exigua* Hubner (male and female) on different sugar beet cultivars.

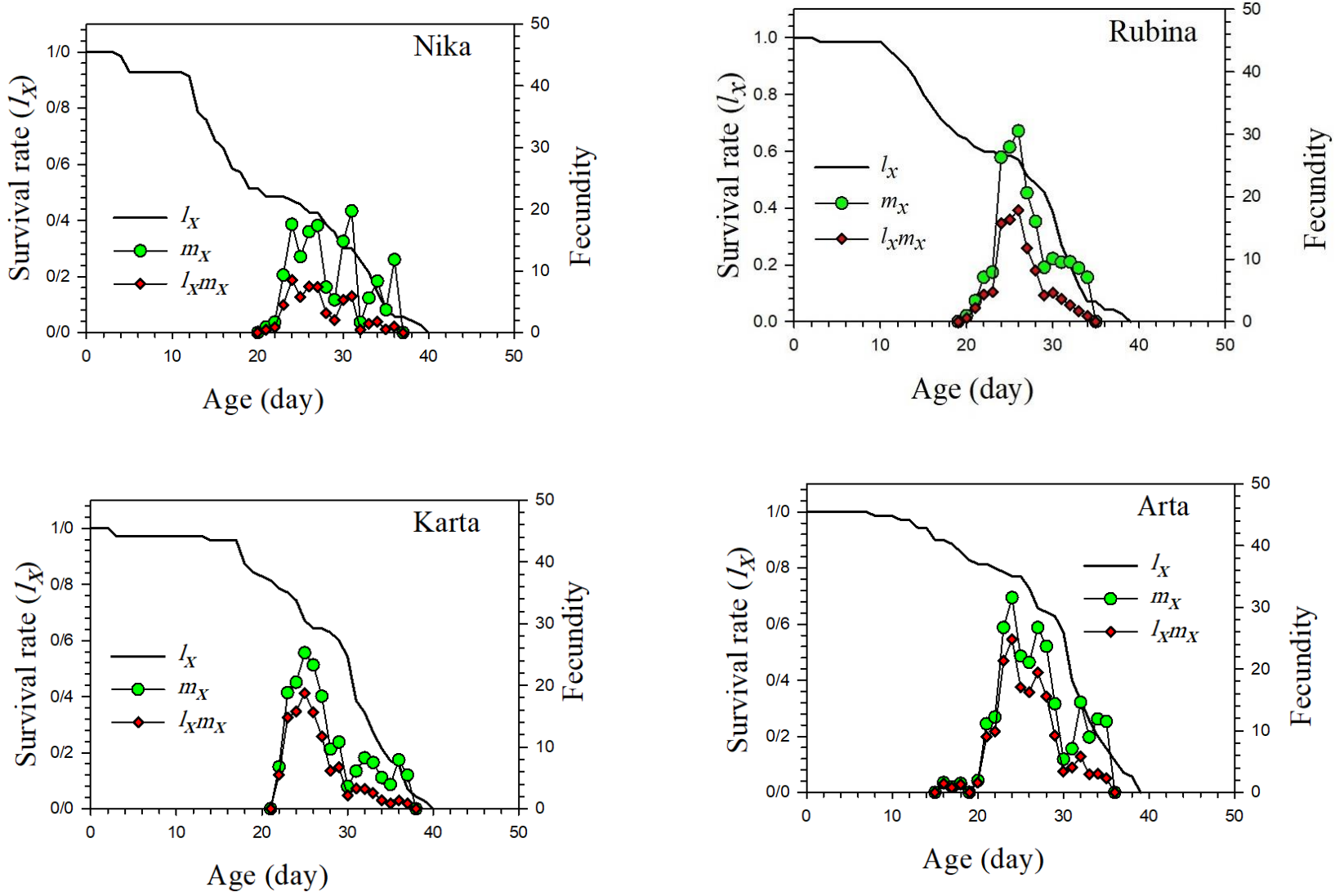


Figure 2. Age-specific survival rate (l_x), age- specific fertility (m_x) and age- specific maternity ($l_x m_x$) of *Spodoptera exigua* Hubner (male and female) on different sugar beet cultivars.

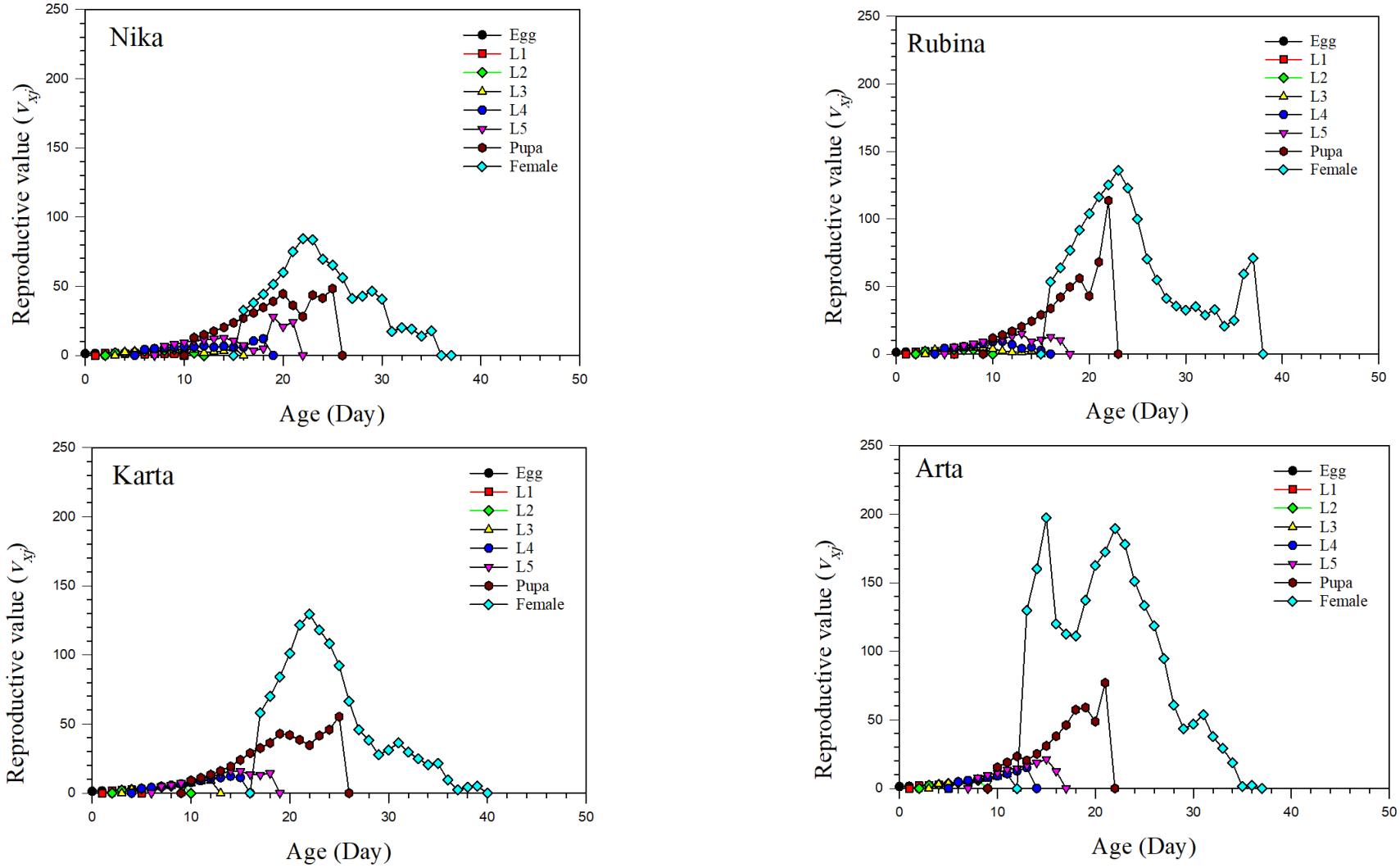
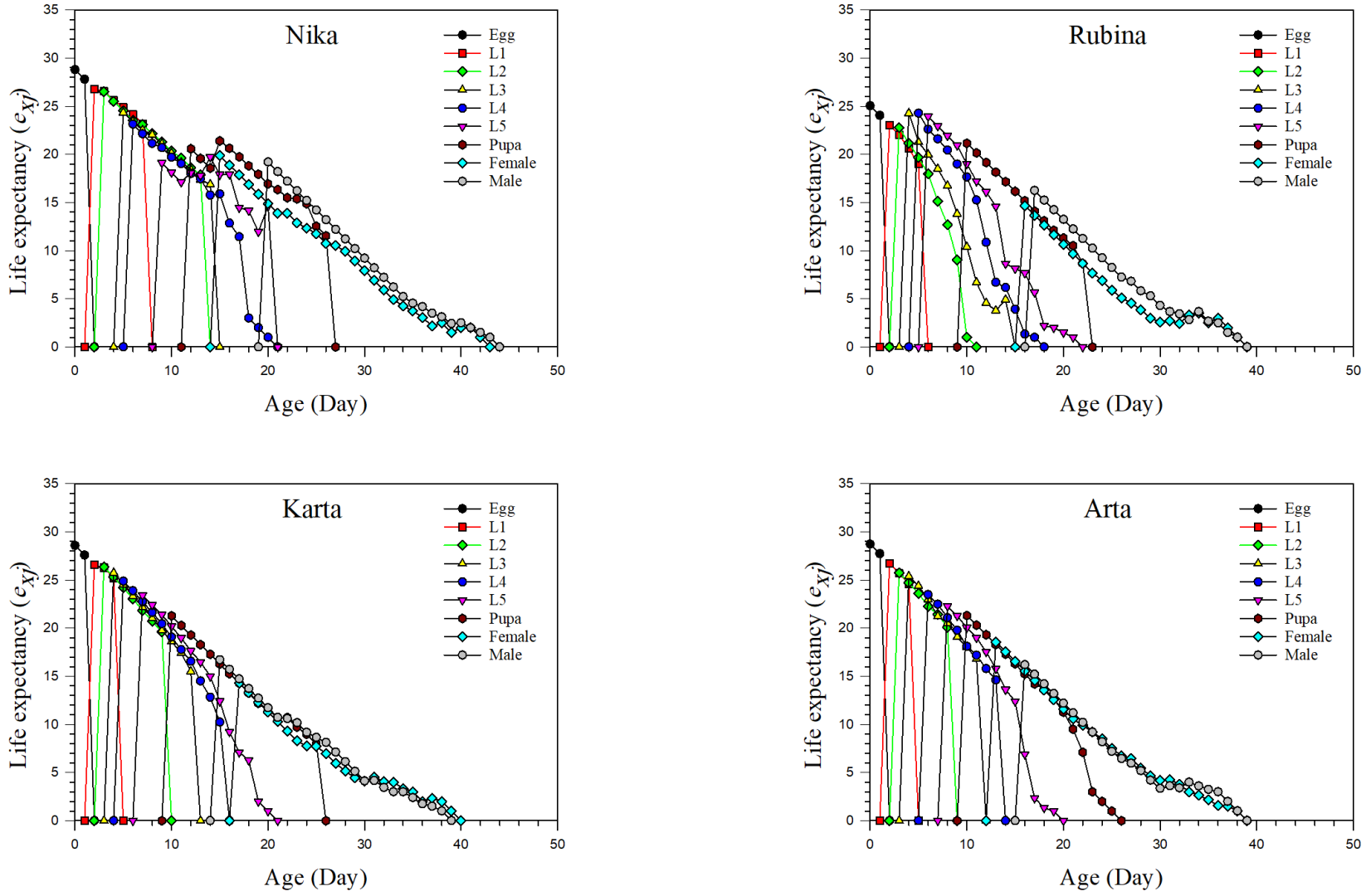


Figure 3. Age-specific reproductive value (v_{xj}) of *Spodoptera exigua* Hubner (male and female) on different sugar beet cultivars.



433 **Figure 4.** **Life expectancy** (e_{xj}) of *Spodoptera exigua* Hubner (male and female) on different sugar beet cultivars.

سازگاری متفاوت ارقام چغندرقند برای کرم برگخوار چغندر (*Spodoptera exigua*): بینش‌هایی از تحلیل جدول زندگی

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چکیده

کرم برگ‌خوار چغندرقند، *Spodoptera exigua* (Hübner) (Lepidoptera: Noctuidae)، یکی از آفات مهم چغندرقند (*Beta vulgaris* L.) در سراسر جهان است که خسارت کمی و کیفی قابل توجهی به این محصول وارد می‌کند. در این مطالعه، پارامترهای زیستی و جمعیتی *S. exigua* روی چهار رقم تجاری چغندرقند ('آرتا'، 'کارتا'، 'نیکا' و 'روبینا') در شرایط آزمایشگاهی با دمای 1±26 درجه سلسیوس، رطوبت نسبی 50-60 درصد و دوره نوری 16:8 ساعت (روشنایی:تاریکی) بررسی شد. پارامترهای جمعیتی با استفاده از روش جدول زندگی اختصاصی سن-مرحله دو جنسی ارزیابی گردید. دوره رشدی تخم در بین ارقام تفاوت معنی‌داری نداشت (حدود 2 روز؛ $p< 0.05$). با این حال، کل مدت رشد پیش‌بالغ (از تخم تا ظهور حشره کامل) در بین رقم‌ها به‌طور معنی‌داری متفاوت بود و در رقم 'کارتا'،کوتاه‌ترین و در رقم 'آرتا' طولانی‌ترین مقدار را داشت. باروری در ارقام مختلف تفاوت چشمگیری داشت، به طوری که بیشترین مقدار آن روی رقم 'آرتا' (382.97 تخم به ازای هر ماده) و کمترین آن روی رقم 'نیکا' (132.37 تخم به ازای هر ماده) مشاهده شد. الگوی مشابهی برای پارامترهای کلیدی جمعیتی نیز دیده شد: نرخ خالص تولیدمثل (R_0) از 56.72 نتاج/فرد روی رقم 'نیکا' تا 169.67 نتاج/فرد روی رقم 'آرتا' متغیر بود. نرخ ذاتی افزایش جمعیت (r) نیز در بین ارقام تفاوت معنی‌داری داشت و از 0.152 در روز روی رقم 'نیکا' تا 0.209 در روز روی رقم 'آرتا' متغیر بود. در مجموع، این نتایج نشان می‌دهد که رقم 'نیکا' در شرایط آزمایشگاهی برای رشد جمعیت *S. exigua* نامناسب‌تر است، در حالی که رقم 'آرتا' مطلوب‌تر به نظر می‌رسد. رشد کندتر جمعیت روی ارقامی مانند 'نیکا' ممکن است به کاهش فشار آفت کمک کند، هرچند این موضوع نیاز به تأیید در شرایط مزرعه دارد. بنابراین، رقم 'نیکا' را می‌توان به عنوان یک مؤلفه بالقوه مفید ، نه به عنوان یک رقم کاملاً مقاوم به تنهایی در برنامه‌های مدیریت تلفیقی آفات (IPM) در نظر گرفت.