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Antixenosis and antibiosis of sweet potato genotypes against Bemisia tabaci

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Abstract

Host plant resistance can reduce insect colonization through antixenosis or impair biological performance through antibiosis. This study aimed to identify orange- and purple-fleshed sweet potato genotypes resistant to *Bemisia tabaci* by distinguishing effects on host choice, oviposition, immature development, and survival. Six genotypes were evaluated in each flesh-color group, including one commercial cultivar as a reference. Choice bioassays quantified adult settling, oviposition, and nymph occurrence, whereas no-choice bioassays determined stage duration, nymphal period, egg-adult period, and viability. Trichome density on the adaxial and abaxial leaf surfaces was quantified by scanning electron microscopy. Among orange-fleshed genotypes, UEO-50 showed the lowest adult settling after 96 h and reductions of 82 to 85% in egg number and 68 to 76% in nymph number compared with FEO-68. In the no-choice assay, UEO-50 prolonged the egg-adult period to 36.9 days and reduced nymphal viability to 24.0%. Among purple-fleshed genotypes, SCS370 Luiza showed the lowest colonization and oviposition, whereas UEP-24 prolonged the egg-adult period to 36.8 days and reduced nymphal viability to 21.2%, indicating resistance mainly associated with antibiosis. Trichome density varied among genotypes but did not consistently explain the resistance patterns. UEO-50 combined evidence of antixenosis and antibiosis, whereas UEP-24 mainly expressed antibiosis. These genotypes represent useful sources for mechanistic studies and subsequent selection stages in sweet potato breeding programs.

Introduction

Sweet potato [*Ipomoea batatas* (L.) Lam.] has broad genetic variability for yield, adaptation, and root composition, which has enabled the selection of cultivars for fresh consumption, processing, and biofortification (Perrud et al., 2024; Gonzalez et al., 2025; Silva Junior et al., 2025; Zeist et al., 2026). Orange- and purple-fleshed genotypes add carotenoids and anthocyanins to the marketable product, increasing the nutritional value and diversity of uses of the crop (Silva et al., 2024; Gonzalez et al., 2025). The expression of this agronomic and nutritional value, however, depends on maintaining vigorous plants and functional leaf area throughout the crop cycle. Therefore, simultaneous selection for yield, root quality, and resistance to arthropods tends to increase the stability of genotypes in production systems exposed to different biotic pressures (Gonzalez et al., 2025; Silva Junior et al., 2025; Leal et al., 2025; Zeist et al., 2026).

Among the insects associated with the crop, *Bemisia tabaci* (Gennadius) deserves attention because of its ability to colonize numerous hosts and exploit the phloem during the adult and nymphal stages (Milenovic et al., 2019; Kavallieratos et al., 2024). The removal of photoassimilates and deposition of honeydew can reduce plant physiological efficiency and favor sooty mold development on the leaf surface (Kavallieratos et al., 2024). The greatest phytosanitary risk, however, results from virus transmission by viruliferous adults during feeding (Clark et al., 2012; Marchant et al., 2020). Begomovirus species and other viruses associated with sweet potato can reduce vigor, leaf expansion, and storage-root reserve accumulation, compromising crop performance even when the vector population is subsequently reduced (Clark et al., 2012; Gibson & Kreuze, 2015).

Vegetative propagation of sweet potato favors virus persistence and dissemination between crop cycles when infected vines are used as planting material (Gibson & Kreuze, 2015). Clonal cleaning reduces the initial pathogen load but does not prevent new infections in areas with vectors and inoculum sources. Under these conditions, the presence of *B. tabaci* can rapidly reestablish infection pressure in fields planted with healthy seedlings (Kavallieratos et al., 2024). For this reason, management should combine virus-free planting material,

monitoring, reduction of inoculum sources, and genetic traits that hinder insect colonization or development (Gibson & Kreuze, 2015; Kavallieratos et al., 2024).

Populations previously referred to as biotype B are currently recognized as Middle East-Asia Minor 1 (MEAM1), a cryptic species widely associated with outbreaks in vegetable crops (Thomas et al., 2025). Its high reproductive capacity, plasticity in host use, and performance favored by high temperatures allow rapid population growth (Kavallieratos et al., 2024). This set of traits increases the frequency of contact between the vector and host plants, favoring both colonization and virus dissemination. In addition, variability in the response of *B. tabaci* to insecticides and recurrent selection exerted by successive applications make exclusively chemical control difficult to maintain, particularly when the objective is to reduce feeding events associated with viral transmission (Kavallieratos et al., 2024).

Host plant resistance can act before and after insect establishment. In antixenosis, visual, tactile, or chemical traits reduce landing, settling, probing, or oviposition (Palial et al., 2022). In antibiosis, the plant affects survival, development rate, fecundity, or other components of biological performance after feeding begins (Baldin et al., 2022; Thomas et al., 2025). These mechanisms are not mutually exclusive and may occur in the same genotype, forming a more complete response than that obtained when only one stage of the interaction is affected (Faria et al., 2021). When integrated with other management practices, genetic resistance reduces crop suitability to the pest without depending on repeated interventions (Stenberg, 2017).

The distinction between antixenosis and antibiosis depends on combining bioassays with complementary purposes. Choice tests compare the relative selection of hosts, allowing the quantification of settling, permanence, and oviposition when genotypes are simultaneously available (Stenberg & Muola, 2017; Palial et al., 2022). No-choice assays confine the insect to a single host and reveal effects on stage duration and survival (Gomes et al., 2025). Integrating these responses prevents a lower number of nymphs from being attributed only to mortality when it may result from lower oviposition, and also prevents a poorly preferred genotype that sustains high performance after establishment from being classified as resistant. Egg and immature-counting methods have been improved to increase the precision of this phenotyping and the efficiency of genotype selection (Devi et al., 2023; van Raalte et al., 2024).

Leaf trichomes are among the morphological components most often associated with plant resistance to sap-sucking insects (Bar & Shtein, 2019; Wang et al., 2021). Non-glandular trichomes can restrict insect movement and access to the epidermis, whereas glandular trichomes add compounds capable of altering settling, feeding, and oviposition (Karabourniotis et al., 2020; Rakha et al., 2017). In sweet potato, glandular peltate structures have already been described on the leaf surface (Lee et al., 2021). In addition, the cultivar SCS370 Luiza showed high trichome density associated with prolonged development, reduced fecundity, and lower preference of *Myzus persicae* (Rech et al., 2024). In other species, resistance to *B. tabaci* also depends on the combination of trichome density, trichome type, and secretion composition (Dias et al., 2016; Zeist et al., 2021).

Despite these advances, information integrating host selection, oviposition, immature development, survival, and trichome density in biofortified sweet potato genotypes exposed to *B. tabaci* remains scarce. Such integration is necessary because genotypes similar in initial colonization may differ in their ability to sustain the insect, whereas materials with contrasting trichome densities may show convergent responses through chemical or physiological defenses (Baldin et al., 2022; Rech et al., 2024). Results obtained with other insects associated with the crop also show that resistance mechanisms vary among genotypes and herbivore species (Leal et al.,

2025). Therefore, identifying resistance sources should simultaneously consider host-choice behavior and insect biological performance in each plant-herbivore interaction.

We hypothesized that orange- and purple-fleshed sweet potato genotypes differ in *B. tabaci* preference and in their ability to sustain its development, and that trichome density contributes to this response without being its sole determinant. Thus, this study aimed to identify genotypes with resistance by antixenosis and antibiosis using choice and no-choice bioassays and to examine the relationships among settling, oviposition, nymph occurrence, development duration, viability, and leaf trichome density.

Materials and Methods

Experimental conditions and evaluated genotypes

The study was conducted at the Ressacada Experimental Farm of the Center for Agricultural Sciences, Federal University of Santa Catarina, in Florianópolis, Santa Catarina, Brazil (27°41'06.28" S; 48°32'38.81" W). The bioassays were conducted in a greenhouse and laboratory under a temperature of 25 ± 2°C, relative humidity of 70 ± 4%, and a 12 h photoperiod.

The *B. tabaci* population used in the bioassays was described as biotype B and originated from insects collected from potato (*Solanum tuberosum* L.) and eggplant (*Solanum melongena* L.) plants maintained under protected cultivation. Adults were collected using an entomological aspirator and transferred to 80 × 60 × 60 cm cages containing common bean (*Phaseolus vulgaris* L.) plants grown in 2.5 dm³ pots. Host plants were replaced as vigor declined to maintain the insect population under suitable conditions for the bioassays.

Orange- and purple-fleshed sweet potato genotypes were evaluated separately. The orange-fleshed group consisted of CEO-28, FEO-68, UEO-20, UEO-50, and UEO-96, in addition to the commercial cultivar Beauregard. The purple-fleshed group included FEP-42, KEP-156, UEP-20, UEP-24, and UEP-30, in addition to the cultivar SCS370 Luiza. The experimental genotypes belong to the sweet potato breeding program of the Federal University of Santa Catarina and were selected after six field-evaluation cycles among 2,383 genotypes based on yield and physical and nutritional root traits. Recent selection of genotypes of different flesh colors has simultaneously considered yield, commercial quality, adaptation, and response to biotic factors (Perrud et al., 2024; Silva et al., 2024; Gonzalez et al., 2025; Zeist et al., 2026). Seedlings were obtained from a maintenance nursery, with no symptoms of pathogens, presence of arthropod pests, or recent residues of phytosanitary products.

Choice test

The orange- and purple-fleshed groups were evaluated in independent bioassays. Seedlings with four to five fully expanded leaves were transplanted to 8 dm³ pots containing a commercial substrate based on biostabilized pine bark. Irrigation was performed using microdrippers, and the remaining crop practices were conducted according to plant needs, without insecticide or fungicide applications. A randomized block design was adopted, with ten replicates, each experimental unit consisting of one plant.

At 18 days after transplanting, the genotypes of each group were simultaneously arranged in 1.5 × 1.5 × 2.0 m greenhouse compartments. The number of leaves was standardized to eight per plant by removing excess leaves. One hundred unsexed *B. tabaci* adults were released per plant. The number of adults settled on the abaxial surface was recorded at 24, 48, 72, and 96 h after release using a mirror on three previously marked leaves in the middle third of each plant.

At 10 and 28 days after infestation, eggs and nymphs were counted. At each evaluation, three young, fully expanded leaves from the middle third were collected, identified, and placed in Gerbox-type boxes. The number of eggs and live nymphs on the abaxial surface was determined using an Olympus BH2 stereoscopic binocular microscope in an area of 4 cm² per leaf, excluding the midrib.

No-choice test

The no-choice assay was conducted in the laboratory with plants maintained in 2 dm³ pots containing a commercial substrate based on biostabilized pine bark. When plants had five to six fully expanded leaves, a plastic cage covered with voile fabric was attached to one leaf. A foam layer at the contact end and a wooden stick were used to support the cage without damaging the leaf blade. Fifty unsexed adults were introduced into each cage and removed after 24 h. The number of eggs was then standardized to 50 per leaf, a procedure compatible with no-choice bioassays used to evaluate antibiosis in *B. tabaci* (Baldin et al., 2022; Gomes et al., 2025).

Bemisia tabaci development was monitored daily. The duration of the incubation period, the four nymphal instars, the nymphal period, and the egg-adult period was determined, as well as nymphal viability and the viability reported as egg-adult viability. The assay was conducted in a completely randomized design, with ten replicates per genotype.

Determination of leaf trichomes

Two days before adult release in the choice test, two leaves per replicate were collected to quantify trichomes on the adaxial and abaxial surfaces. Leaf fragments were fixed in 2.5% glutaraldehyde prepared in 0.1 mol L^{-1} phosphate buffer, pH 7.2, dehydrated in an increasing ethanol series, critical-point dried, mounted on metallic stubs with carbon tape, and gold-coated. Observations were performed using a scanning electron microscope. Four fields of 1 cm² were evaluated per leaf surface, totaling 4 cm² per sample.

Statistical analysis

The normality of residuals and homogeneity of variances were checked before analysis of variance. When necessary, count data were transformed by $\sqrt{(x + 0.5)}$, while means in tables and figures were retained on the original scale. Genotype means were compared by Tukey's test at 5% probability. Associations among antixenosis, development, viability, and trichome-density variables were examined separately for the orange- and purple-fleshed groups using Spearman correlations, presented as heat maps. Analyses were performed using R software, adopting $\alpha = 0.05$.

Results

Antixenosis of Bemisia tabaci in sweet potato genotypes

Adult settling differed among orange-fleshed genotypes across the four evaluations. UEO-50 showed the lowest adult numbers and, after 96 h, had a 60% reduction compared with FEO-68, the genotype with the highest colonization (Fig. 1). Oviposition and nymph number followed the same pattern. Compared with FEO-68, UEO-50 showed 82 to 85% fewer eggs and 68 to 76% fewer nymphs in the evaluations performed at 10 and 28 days (Fig. 2).

Among purple-fleshed genotypes, SCS370 Luiza showed the lowest adult numbers in all evaluations, whereas FEP-42 showed the highest colonization. UEP-24 was among the experimental genotypes with lower adult settling (Fig. 3). SCS370 Luiza also showed the lowest numbers of eggs and nymphs at 10 and 28 days, whereas FEP-42 showed the highest values. UEP-24 showed an intermediate response for oviposition and nymph occurrence (Fig. 4).

Development and viability of Bemisia tabaci in the no-choice test

In the orange-fleshed group, UEO-50 prolonged the second, third, and fourth instars, as well as the nymphal and egg-adult periods. The egg-adult period reached 36.9 days, an increase of 7.6 days compared with Beauregard, and nymphal viability was reduced to 24.0%. FEO-68 showed an egg-adult period of 29.8 days and the highest nymphal viability, 51.2% (Table 1).

Table 1
Duration of stages, nymphal and egg-adult periods, and viability of *Bemisia tabaci* in orange-fleshed sweet potato genotypes.

Genotype	(days)								
	Incubation	**1st instar**	**2nd instar**	**3rd instar**	**4th instar**	**Nymphal period**	**Egg-adult period**	**Nymphal viability (%)**	**Egg-adult viability (%)**
Beauregard	9.4 ± 0.27	2.0 ± 0.15	4.1 ± 0.1 c	8.3 ± 0.15 d	5.5 ± 0.17 b	19.9 ± 0.28 d	29.3 ± 0.52 e	50.22 ± 0.79 a	94.4 ± 0.83 ab
CEO-28	9.5 ± 0.22	2.6 ± 0.16	5.5 ± 0.17 b	9.3 ± 0.15 b	7.4 ± 0.22 a	24.8 ± 0.39 b	34.3 ± 0.47 b	30.21 ± 1.43 b	92.2 ± 1.25 bc
FEO-68	9.4 ± 0.22	2.1 ± 0.18	4.1 ± 0.1 c	8.6 ± 0.16 cd	5.6 ± 0.16 b	20.4 ± 0.34 d	29.8 ± 0.44 de	51.18 ± 1.14 a	97.8 ± 0.63 a
UEO-20	9.5 ± 0.17	2.4 ± 0.16	5.0 ± 0.0 b	8.4 ± 0.16 cd	6.0 ± 0.0 b	21.8 ± 0.2 c	31.3 ± 0.3 cd	30.98 ± 1.3 b	93.0 ± 0.8 bc
UEO-50	10.2 ± 0.25	2.4 ± 0.16	6.4 ± 0.31 a	10.5 ± 0.17 a	7.4 ± 0.4 a	26.7 ± 0.45 a	36.9 ± 0.48 a	23.97 ± 0.67 c	90.2 ± 1.17 c
UEO-96	9.4 ± 0.16	2.6 ± 0.16	5.3 ± 0.15 b	9.0 ± 0.0 bc	6.0 ± 0.0 b	22.9 ± 0.18 c	32.3 ± 0.26 c	30.81 ± 1.18 b	92.8 ± 1.12 bc

Means followed by different letters differ significantly among genotypes by Tukey's test ($p \leq 0.05$). When letters are not shown, there was no significant genotype effect.

In the purple-fleshed group, SCS370 Luiza and UEP-24 showed the longest nymphal periods, 27.2 and 26.5 days, respectively, and egg-adult periods, 37.7 and 36.8 days. These genotypes also showed the lowest nymphal viability, 20.7% in SCS370 Luiza and 21.2% in UEP-24. UEP-20 showed the shortest egg-adult period and the highest nymphal viability (Table 2).

Table 2
Duration of stages, nymphal and egg-adult periods, and viability of *Bemisia tabaci* in purple-fleshed sweet potato genotypes.

Genotype	(days)							Nymphal viability (%)	Egg-adult viability (%)
	Incubation	1st instar	2nd instar	3rd instar	4th instar	Nymphal period	Egg-adult period		
Luiza	10.5 ± 0.17 a	2.3 ± 0.15 ab	6.6 ± 0.16 a	10.5 ± 0.17 a	7.8 ± 0.2 a	27.2 ± 0.29 a	37.7 ± 0.3 a	20.7 ± 1.04 c	86.8 ± 1.5 b
FEP-42	9.1 ± 0.1 b	2.3 ± 0.15 ab	5.2 ± 0.13 b	8.6 ± 0.16 bc	6.2 ± 0.13 b	22.3 ± 0.26 b	31.4 ± 0.27 b	40.28 ± 0.73 b	88.8 ± 1.16 ab
KEP-156	9.2 ± 0.13 b	2.4 ± 0.16 ab	5.4 ± 0.16 b	8.7 ± 0.15 bc	5.8 ± 0.13 bc	22.3 ± 0.33 b	31.5 ± 0.31 b	38.27 ± 0.75 b	89.2 ± 0.9 ab
UEP-20	8.9 ± 0.1 b	1.9 ± 0.1 b	4.0 ± 0.0 c	8.1 ± 0.1 c	5.2 ± 0.13 c	19.9 ± 0.28 c	29.3 ± 0.52 c	55.93 ± 0.92 a	92.6 ± 0.85 a
UEP-24	10.3 ± 0.15 a	2.6 ± 0.16 a	6.2 ± 0.2 a	9.9 ± 0.23 a	7.8 ± 0.13 a	26.5 ± 0.31 a	36.8 ± 0.39 a	21.2 ± 0.64 c	90.4 ± 0.78 ab
UEP-30	9.0 ± 0.21 b	2.4 ± 0.16 ab	5.3 ± 0.15 b	8.8 ± 0.13 b	6.0 ± 0.15 b	22.5 ± 0.34 b	31.5 ± 0.45 b	37.42 ± 1.32 b	90.4 ± 0.58 ab

Means followed by different letters differ significantly among genotypes by Tukey's test ($p \leq 0.05$). When letters are not shown, there was no significant genotype effect.

Characterization of leaf trichomes

In orange-fleshed genotypes, UEO-96 showed the highest trichome density on the abaxial surface, 26.1 trichomes per 4 cm². On the adaxial surface, CEO-28 and Beauregard showed the highest densities, 49.1 and 47.9 trichomes per 4 cm², respectively. UEO-50 had no trichomes on the abaxial surface and showed 13.3 trichomes per 4 cm² on the adaxial surface (Table 3).

Table 3
Trichome density on the abaxial and adaxial surfaces of leaves of orange-fleshed sweet potato genotypes.

Trichomes – Orange-fleshed genotypes – 4 cm²		
Genotypes	**Abaxial**	**Adaxial**
Beauregard	0 b	47.9 a
CEO-28	0.1 b	49.1 a
FEO-68	0 b	0 c
UEO-50	0 b	13.3 b
UEO-20	0 b	1.6 c
UEO-96	26.1 a	0 c
CV%	96.8	43.3

Means followed by different letters differ significantly among genotypes by Tukey's test ($p \leq 0.05$).

SCS370 Luiza showed the highest trichome density on both leaf surfaces and was the only purple-fleshed genotype with trichomes on the abaxial surface, with 103.1 trichomes per 4 cm². On the adaxial surface, the cultivar showed 27.3 trichomes per 4 cm², followed by KEP-156, with 8.8 trichomes per 4 cm² (Table 4).

Table 4
Trichome density on the abaxial and adaxial surfaces of leaves of purple-fleshed sweet potato genotypes. Means followed by different letters differ significantly among genotypes by Tukey's test ($p \leq 0.05$).

Trichomes – Purple-fleshed genotypes – 4 cm²		
Genotypes	**Abaxial**	**Adaxial**
SCS370 Luiza	103.1 a	27.3 a
UEP-24	0 b	2.1 c
FEP-42	0 b	0.1 c
UEP-20	0 b	0.8 c
UEP-30	0 b	1 c
KEP-156	0 b	8.8 b
CV%	21.5	28.4

Means followed by different letters differ significantly among genotypes by Tukey's test ($p \leq 0.05$).

Association among antixenosis and antibiosis parameters

In the orange-fleshed group, the numbers of adults, eggs, and nymphs were positively associated with each other. The duration of stages and development periods was generally negatively associated with abundance variables, whereas nymphal viability showed a positive association with the number of individuals (Fig. 5).

In the purple-fleshed group, the durations of incubation, instars, and the nymphal and egg-adult periods were negatively associated with abundance variables. Instar durations were positively correlated with each other and negatively associated with nymphal viability (Fig. 6).

Discussion

Sweet potato genotypes differed both in initial host selection and in their ability to sustain *B. tabaci* development. UEO-50 reduced adult settling, oviposition, and nymph number and, in the no-choice assay, prolonged development and reduced nymphal viability. Among purple-fleshed genotypes, SCS370 Luiza combined lower colonization with lower insect suitability, whereas UEP-24 mainly affected immature development. These patterns demonstrate that resistance was expressed at distinct stages of the plant-insect interaction and that antixenosis and antibiosis contributed differently among genotypes.

UEO-50 showed the lowest adult settling and oviposition among orange-fleshed genotypes, with a reduction also in nymph number (Figs. 1 and 2). Adult permanence on the abaxial surface represents a stage preceding oviposition and depends on the integration of visual, olfactory, and tactile stimuli perceived before and during the first probes. Volatile compounds can guide host approach, whereas leaf-surface traits and chemical cues perceived by the stylets influence insect acceptance and permanence (Milenovic et al., 2019; Mrisho et al., 2021; Pimkornburee et al., 2024). Thus, the lower number of adults and eggs on UEO-50 indicates that the genotype interfered with host selection and oviposition-site choice, characterizing antixenosis.

Resistance in UEO-50 remained evident when the insect had no host alternative. The second, third, and fourth instars were prolonged, the nymphal period reached 26.7 days, the egg-adult period reached 36.9 days, and nymphal viability was reduced to 24.0% (Table 1). Prolongation of the immature stages indicates that the phloem offered lower nutritional suitability or imposed a higher physiological cost for maintenance, feeding, and detoxification. The composition of amino acids and sugars in the sap, associated with the presence of defensive metabolites, can alter the development rate and survival of phloem-feeding insects (Mansaray & Sundufu, 2009; Li et al., 2016; Isah, 2019). Similar responses, with increased development duration and reduced survival, have been used to characterize antibiosis to *B. tabaci* in different hosts (Baldin et al., 2022; Gomes et al., 2025; Thomas et al., 2025).

FEO-68 showed the opposite pattern, with higher settling, oviposition, and nymph number, an egg-adult period of 29.8 days, and nymphal viability of 51.2% (Figs. 1 and 2; Table 1). The association between greater initial acceptance and better performance of immature stages favors colony formation because more females remain on the host, deposit more eggs, and produce nymphs that complete development in less time. This correspondence between preference and host suitability has been observed in interactions of *B. tabaci* with contrasting genotypes, although the two components may also vary independently (Mansaray & Sundufu, 2009; Baldin et al., 2022; Thomas et al., 2025). The contrast between UEO-50 and FEO-68 provides a useful basis for investigating the traits that determine resistance and susceptibility and for guiding crosses in breeding programs.

In the purple-fleshed group, SCS370 Luiza showed the lowest numbers of adults, eggs, and nymphs and, simultaneously, prolonged the nymphal and egg-adult periods and reduced nymphal viability (Figs. 3 and 4; Table 2). UEP-24 showed development duration and nymphal viability similar to those of the cultivar but received more adults, eggs, and nymphs. Therefore, SCS370 Luiza combined antixenosis and antibiosis, whereas UEP-24 mainly expressed antibiosis. Initial host choice and host quality after feeding are partially independent components of resistance, because a genotype may be accepted for oviposition and still limit progeny development through nutritional or defensive traits of the leaf tissue (Milenovic et al., 2019; Palial et al., 2022; Thomas et al., 2025).

The sequence from settling to oviposition and nymph occurrence was consistent in both genotype groups. FEO-68 and FEP-42 maintained higher adult numbers, received more eggs, and showed higher nymph numbers, whereas UEO-50 and SCS370 Luiza restricted colonization from the initial stages (Figs. 1 to 4). This continuity is expected when host acceptance favors female permanence and increases egg deposition. However, the number of nymphs in the choice test integrates at least two processes, the initial number of eggs and survival after hatching. Therefore, evidence of antibiosis is mainly provided by the no-choice assay, in which the initial number of eggs was standardized and differences in duration and viability could be attributed to insect performance on the respective genotype (Stenberg & Muola, 2017; Palial et al., 2022).

SCS370 Luiza showed 103.1 trichomes per 4 cm² on the abaxial surface and 27.3 trichomes per 4 cm² on the adaxial surface, densities higher than those of the other purple-fleshed genotypes (Table 4). High pubescence on the abaxial surface is compatible with the lower colonization observed because this is the preferred surface for *B. tabaci* settling and oviposition. Trichomes can restrict movement, hinder body approach to the epidermis, reduce stability during probing, and alter the availability of suitable sites for egg deposition (Bar & Shtein, 2019; Karabourniotis et al., 2020; Wang et al., 2021). The same cultivar also prolonged development, reduced fecundity, and showed lower preference by *Myzus persicae*, indicating that its leaf surface has an unfavorable effect on different sap-sucking insects (Rech et al., 2024). The presence of glandular peltate trichomes described in sweet potato also allows the joint action of a physical barrier and secreted compounds to be considered (Lee et al., 2021).

The response of orange-fleshed genotypes shows, however, that trichome density does not alone explain resistance. UEO-50 had no trichomes on the abaxial surface and had lower adaxial density than Beauregard and CEO-28, but it was the least colonized genotype and the one that most restricted insect development. UEO-96 showed the highest abaxial density in the group without reproducing the UEO-50 pattern (Table 3). Trichome efficiency depends on morphology, rigidity, orientation, and possible exudate production, in addition to interaction with other leaf-surface traits. Therefore, genotypes with similar densities may differ in response to *B. tabaci*, and high pubescence does not always correspond to lower colonization (Rakha et al., 2017; Murgianto et al., 2023; Zeist et al., 2021). In this set, trichomes provide a coherent explanation for part of the response of SCS370 Luiza, but other traits must account for the resistance of UEO-50.

The lower suitability of UEO-50 and UEP-24 may be related to the chemical and physiological composition of the leaves. During probing, *B. tabaci* evaluates host quality, and differences in the concentration and balance of amino acids, sugars, and other phloem solutes may alter ingestion, growth, and survival (Milenovic et al., 2019; Mansaray & Sundufu, 2009). Phenolic compounds, terpenoids, defense proteins, and jasmonate-regulated responses can also increase the metabolic cost of feeding or interfere with nutrient use (Li et al., 2016; Isah,

2019). In tomato, acylsugars modified settling, oviposition, development, and virus incidence, demonstrating that chemical traits can act simultaneously on antixenosis and antibiosis (Dias et al., 2016; Marchant et al., 2020; Smeda et al., 2023). This model helps explain why UEO-50 showed resistance even with low trichome density.

The correlations summarized the link between behavioral and biological stages. Positive associations among adults, eggs, and nymphs show that more accepted genotypes also sustained greater progeny establishment (Figs. 5 and 6). Equivalent relationships between oviposition preference and immature performance have been described in different hosts of *B. tabaci* (Mansaray & Sundufu, 2009; Baldin et al., 2022). Conversely, longer development periods were associated with lower viability and lower abundance, a pattern expected when the host delays progression through instars and reduces the success of immature stages (Baldin et al., 2022; Thomas et al., 2025). In purple-fleshed genotypes, this axis was represented mainly by SCS370 Luiza and UEP-24, whereas UEP-20 combined faster development and higher nymphal viability.

The combination of antixenosis and antibiosis increases the usefulness of resistance in *B. tabaci* management. Antixenosis reduces the number of adults that remain and oviposit, whereas antibiosis prolongs development and decreases the proportion of individuals reaching the adult stage (Stenberg & Muola, 2017; Baldin et al., 2022). In a vegetatively propagated crop subject to virus dissemination, these mechanisms should complement the use of healthy seedlings, elimination of inoculum sources, and vector monitoring (Clark et al., 2012; Gibson & Kreuze, 2015). Resistance traits that reduce permanence, oviposition, and development may also decrease colonization intensity throughout the crop cycle and, in some interactions, contribute to lower viral incidence (Marchant et al., 2020; Smeda et al., 2023).

UEO-50 is the main resistance source among orange-fleshed genotypes because it combines interference with host choice and lower suitability for development. UEP-24 adds a source of antibiosis among experimental purple-fleshed genotypes, whereas SCS370 Luiza represents the combination of both mechanisms. These genotypes have already been selected in a program oriented toward yield and physical and nutritional root traits, which favors their use in crosses aimed at combining agronomic performance and resistance (Silva Junior et al., 2025; Zeist et al., 2026). The integrated evaluation of settling, oviposition, duration, and viability allows the selection of genotypes with complementary responses and avoids inferring resistance from a single leaf trait or from only one stage of the plant-insect interaction (Stenberg & Muola, 2017; Palial et al., 2022).

Conclusion

UEO-50 showed resistance by antixenosis and antibiosis, with lower settling and oviposition and lower suitability for *B. tabaci* development. Among purple-fleshed genotypes, SCS370 Luiza combined both mechanisms, whereas UEP-24 showed resistance predominantly associated with antibiosis.

Lower host choice and reduced development and survival of *B. tabaci* made it possible to distinguish genotypes with different combinations of antixenosis and antibiosis. Trichome density was not uniformly related to these responses and, therefore, did not constitute an isolated criterion to explain resistance among the evaluated genotypes.

Declarations

Conflict of Interest

The authors declare no conflict of interest

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Author Contribution

JRSDP: assisted with the experiment, data analysis, and manuscript writing. JABG: conducted the experiment, assisted with the statistical analyses, and reviewed the manuscript. ARZ: planned and supervised the experiment and reviewed the manuscript.

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Figures

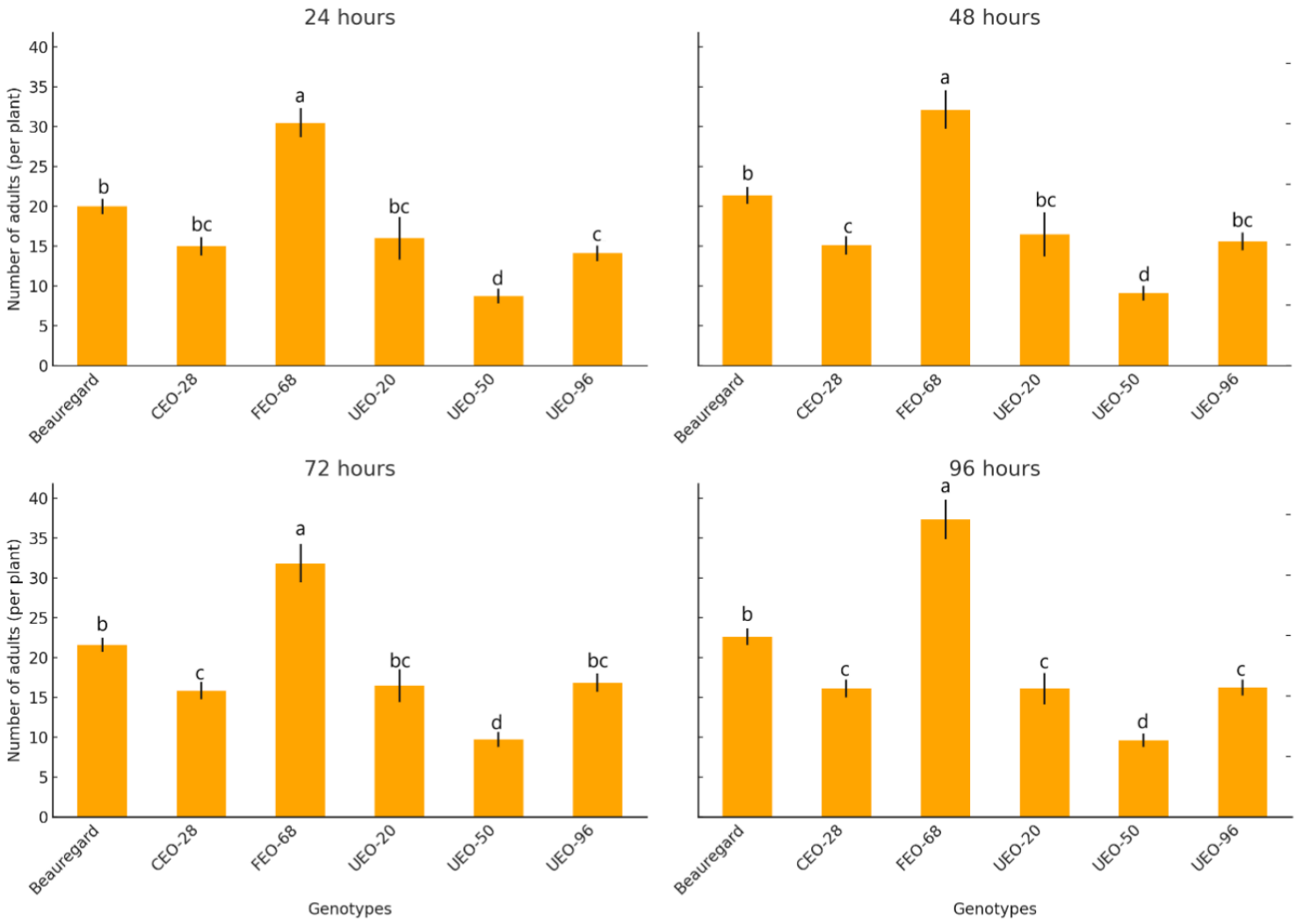

Figure 1

Mean number of *Bemisia tabaci*adults settled on the abaxial leaf surface of orange-fleshed sweet potato genotypes at 24, 48, 72, and 96 h after release. Bars represent means ± standard error; different letters indicate differences by Tukey's test ($p \leq 0.05$).

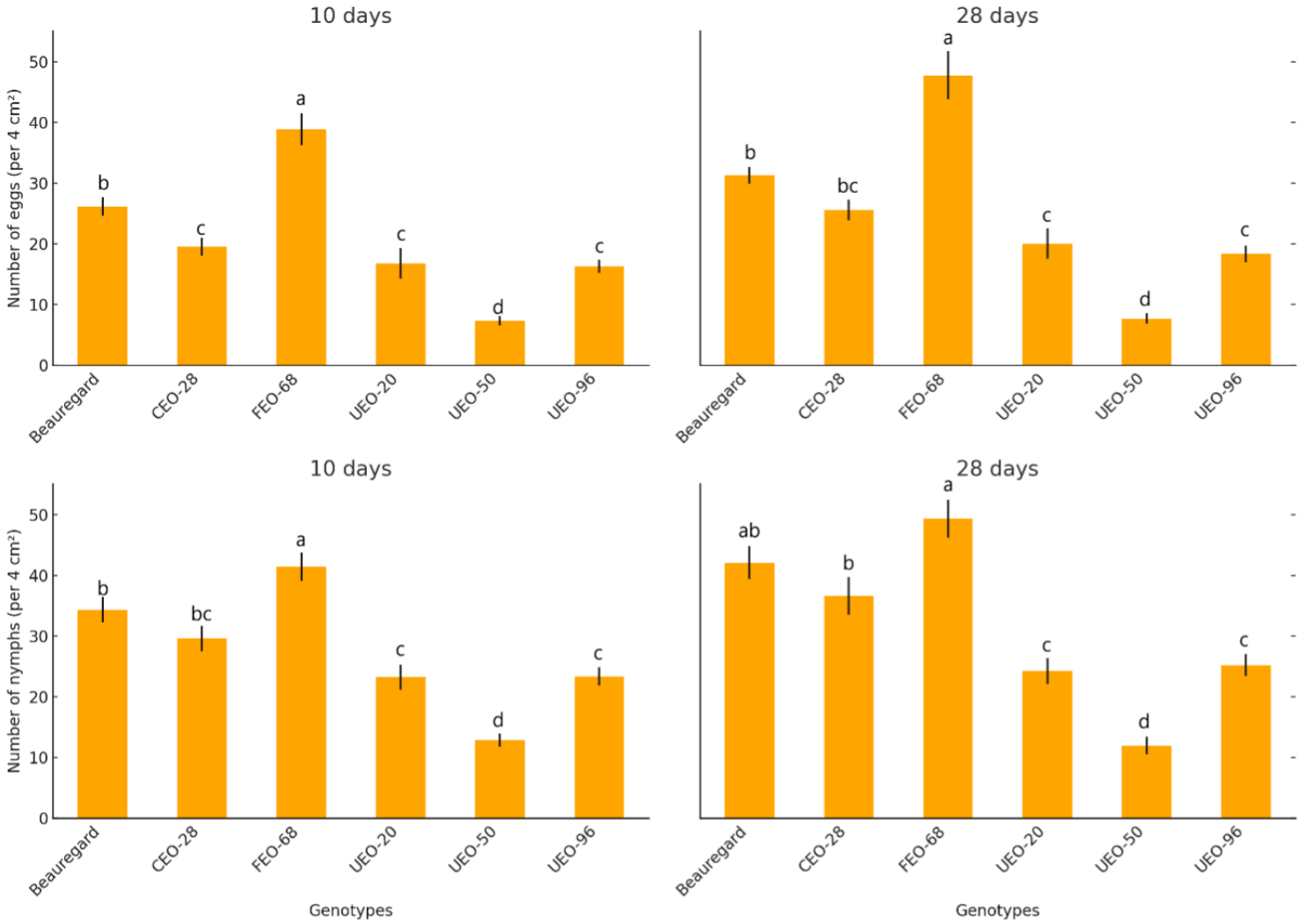

Figure 2

Mean number of *Bemisia tabaci* eggs and nymphs per 4 cm² of the abaxial leaf surface of orange-fleshed sweet potato genotypes at 10 and 28 days after infestation. Bars represent means ± standard error; different letters indicate differences by Tukey's test ($p \leq 0.05$).

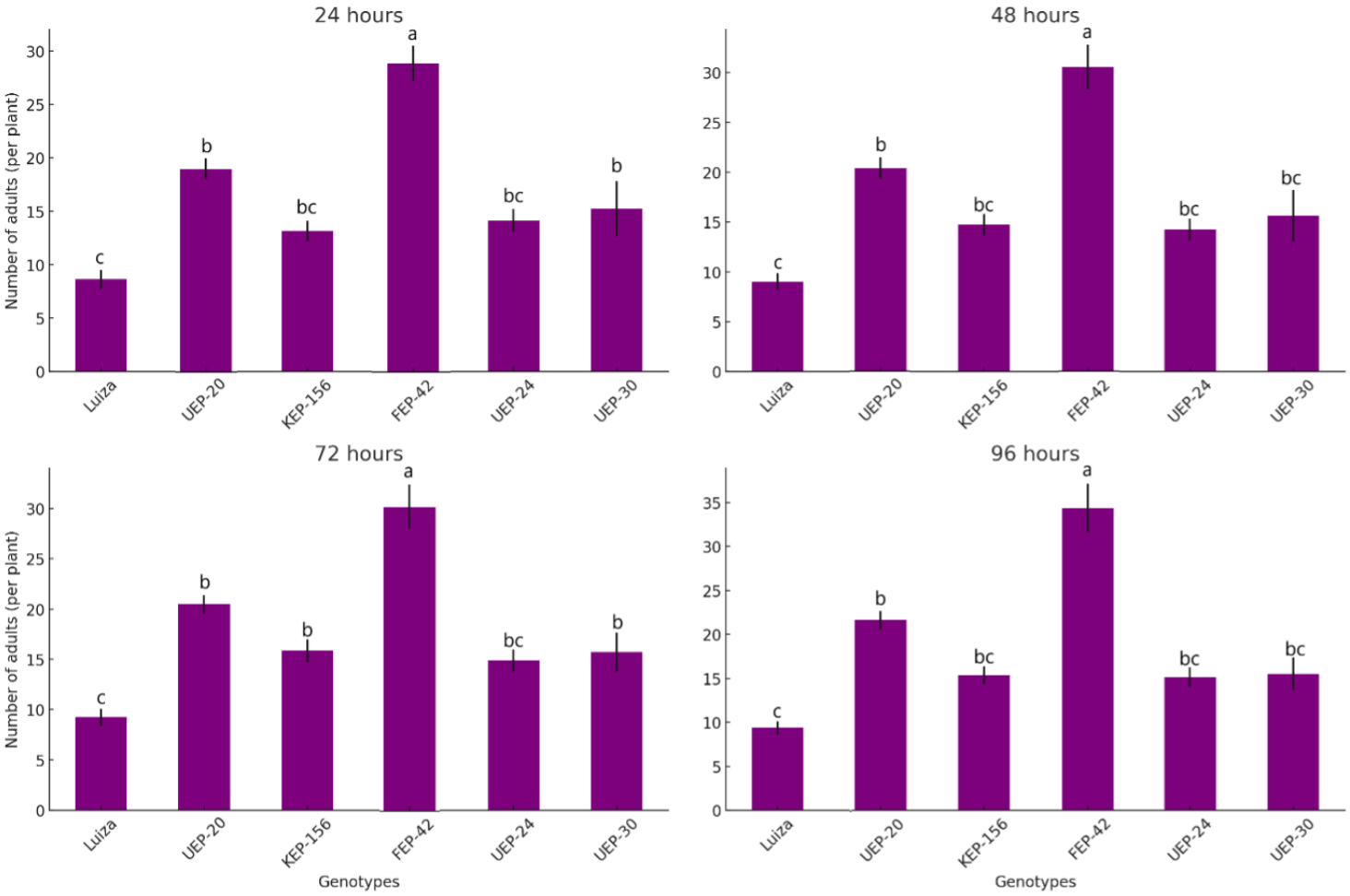

Figure 3

Mean number of *Bemisia tabaci*adults settled on the abaxial leaf surface of purple-fleshed sweet potato genotypes at 24, 48, 72, and 96 h after release. Bars represent means ± standard error; different letters indicate differences by Tukey's test (p ≤ 0.05).

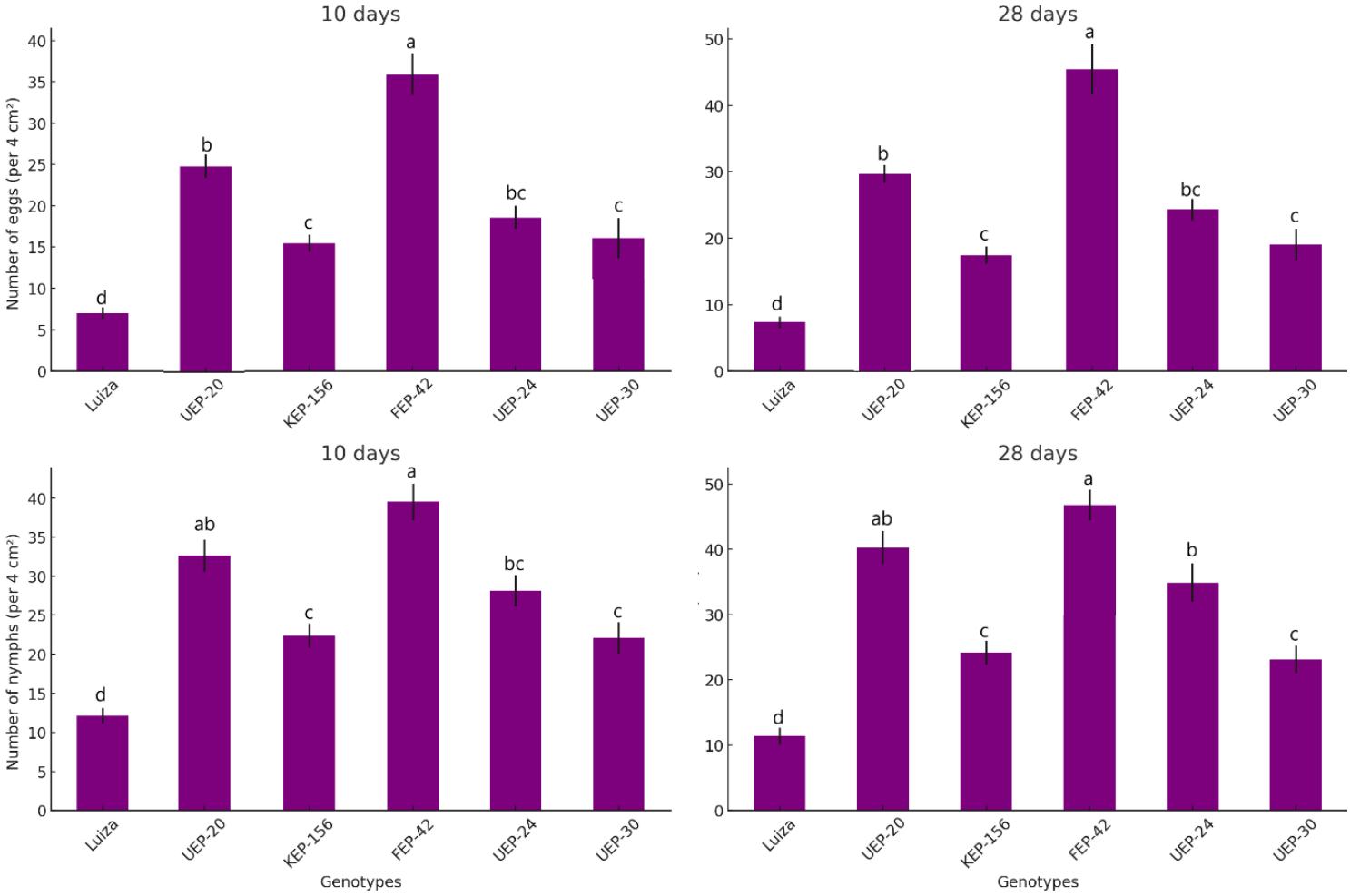

Figure 4

Mean number of *Bemisia tabaci*eggs and nymphs per 4 cm² of the abaxial leaf surface of purple-fleshed sweet potato genotypes at 10 and 28 days after infestation. Bars represent means ± standard error; different letters indicate differences by Tukey's test ($p \leq 0.05$).

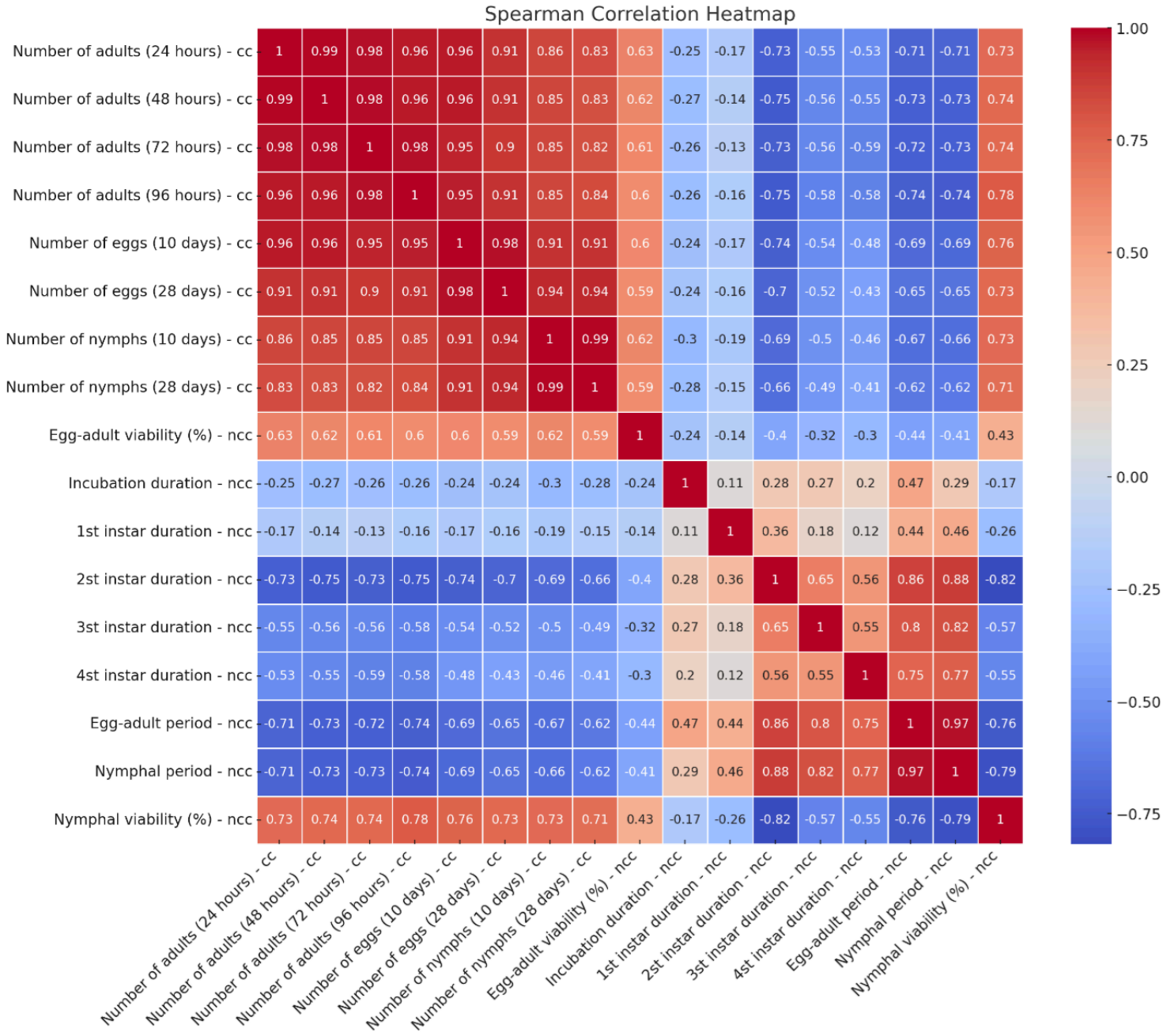

Figure 5

Spearman correlation coefficients among colonization, development, viability, and trichome-density variables in orange-fleshed sweet potato genotypes.

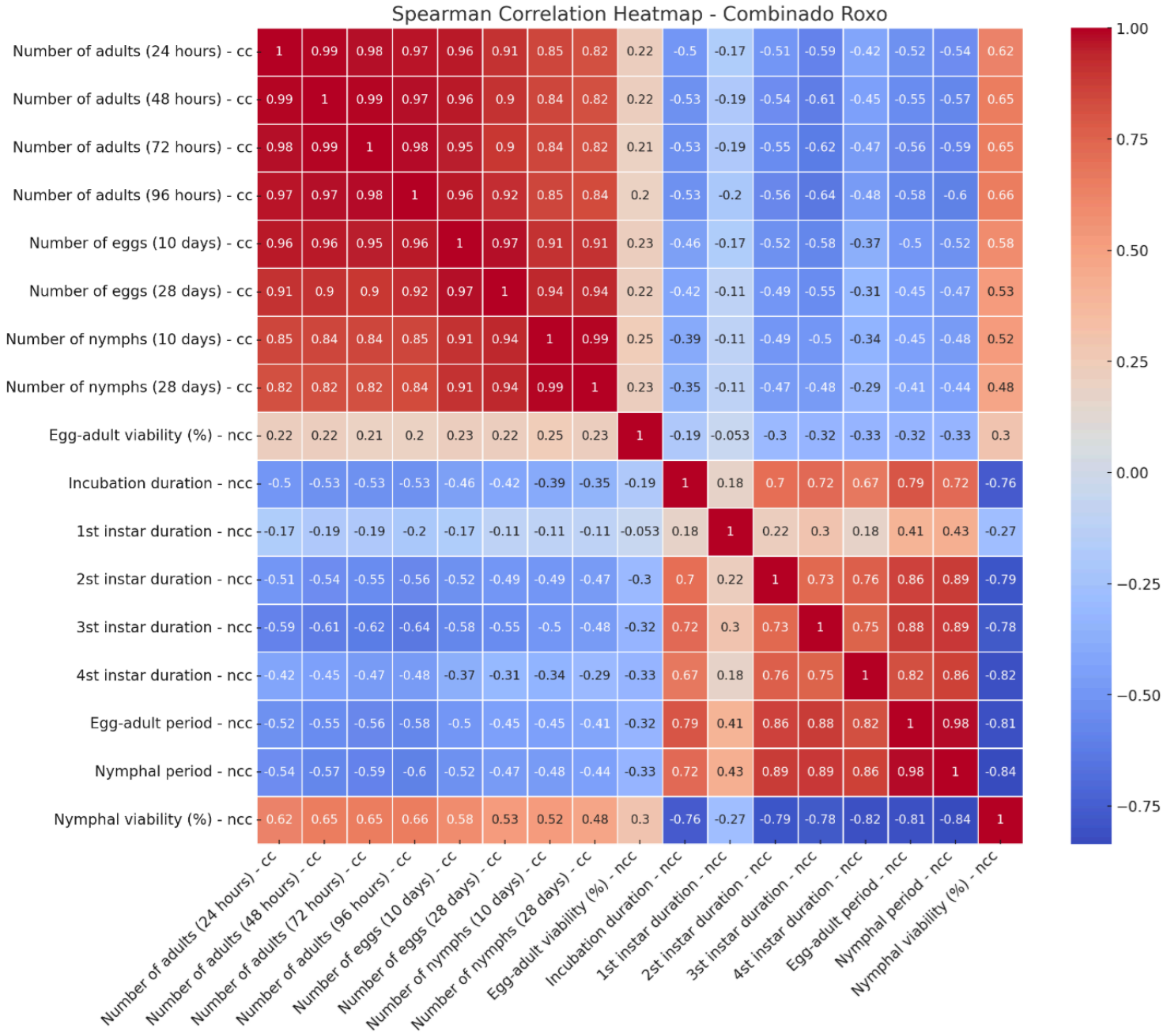

Figure 6

Spearman correlation coefficients among colonization, development, viability, and trichome-density variables in purple-fleshed sweet potato genotypes.