Research article

Ecology Journal

ISSN (Print): 2957-4471, ISSN (Online): 2957-448X, Website: https://journal.esbangladesh.org
Ecol. J. (2025) 7 (3) : 235-244

Plant characteristics and predator-prey abundance modulate aphid infestation and yield in bean cultivars

Rinki Akter, Md. Mamunur Rahman, Priyanka Roy, Hania Binta Aslam, Farha Tamanna Ila Haque and Md Ruhul Amin*

Department of Entomology, Gazipur Agricultural University, Gazipur, Bangladesh.

***Corresponding e-mail:** mramin@gau.edu.bd

Received: 30 November 2025, revised: 09 December 2025, accepted: 10 December 2025, DOI: https: //doi.org/10.59619/ej.7.3.7

Abstract

Country bean is an important leguminous crop in Bangladesh, contributing to household income and nutritional security, although its production is constrained by insect pests, particularly the aphid. This study was conducted to assess how plant traits and predator abundance affect aphid infestation and yield in country bean. Five cultivars (BARI Bean 1, BARI Bean 5, BARI Bean 6, BARI Bean 7, and BARI Bean 10) were evaluated in the field in a randomized complete block design. Weekly observations recorded plant growth, aphid and predator populations, and leaf and fruit infestation, along with measurements of morphological and biochemical traits and yield. Results revealed a significant variation among cultivars in growth and biochemical traits. Branch initiation ranged from 27 days after sowing (BARI Bean 6) to 40 days after sowing (BARI Bean 5), and fruit maturation ranged from 83.8 days after sowing (BARI Bean 5) to 123.8 days after sowing (BARI Bean 10). Aphid abundance was the highest on BARI Bean 5 (9.2 leaf^{-1}), lowest on BARI Bean 1 (2.8 leaf^{-1}), infestation of leaves peaked to 11.6% on BARI Bean 5 and was lowest (2.7%) in BARI Bean 10. Predator abundance per plot varied; ladybird beetles were highest on BARI Bean 5 (4.3) and lowest on BARI Bean 10 (1.3). Yield components differed significantly, with BARI Bean 10 producing the widest fruits (2.83 cm), the heaviest seeds (53.9 g), and the highest yield (0.2 t ha^{-1}), whereas BARI Bean 5 had the smallest fruits (7.8 cm), the lightest seeds (31.2 g), and the lowest yield (0.01 t ha^{-1}). So, BARI Bean 10 emerged as the most suitable cultivar due to low aphid infestation and high yield, while BARI Bean 5 found to be the most susceptible one.

Keywords: Abundance, *Aphis craccivora*, infestation, *Lablab purpureus*, predator, yield

Introduction

Bean is an important leguminous vegetable, fodder, and cover crop contributing to household income and nutritional security in Bangladesh. Among bean crops, country bean (*Lablab purpureus* L.) is widely cultivated during the rabi season. However, some heat tolerant country bean varieties are also growing in the kharif season (Mollah *et al.* 2017) with the approximate yield of 6.11 ton/ha (Mollah *et al.* 2013). In the 2022–2023 season, country bean production in Bangladesh reached to 228.1 thousand metric tonnes from approximately 257.6 thousand hectares, underscoring its importance as a staple vegetable crop (BBS 2023). However, national production has stagnated in recent years.

Country bean is attacked by approximately 55 species of insect pests and mites from seedling to harvest stages (Chopkar *et al*. 2020). Major pests include aphids, bean bugs, semiloopers, leaf miners, pod borers, shoot borers, epilachna beetles, and mites (Chowdhury *et al*. 2019). However, jute hairy caterpillar, stink bug and bean weevil are also prevalent during summer season (Mollah *et al.* 2022; Mollah 2022). Among these, the bean aphid, *Aphis craccivora* Koch, is one of the most destructive. This polyphagous pest causes direct damage through sap sucking from twigs, bean pod as well as inflorescence (Mollah *et al.* 2013) and indirect damage by transmitting viral diseases (Malik *et al*. 1988). In Bangladesh, insect pests and diseases together can cause 30-40% yield losses in country bean, with aphids consistently identified as a key pest across production regions (Rahman *et al*. 2022). Aphid infestation reduces plant vigor, deforms leaves and pods, diminishes photosynthetic capacity, and causes significant yield loss. Moreover, aphids efficiently transmit several economically important viruses, including bean common mosaic virus, yellow mosaic, necrotic yellow, and leaf roll viruses, which under favorable conditions may result in severe yield loss or complete crop failure (Verma *et al*. 2010). Consequently, aphid infestation remains a major constraint to sustainable country bean production, particularly for smallholder farmers.

Aphid population density is influenced by host plant characteristics, and infestation levels vary among cultivars. Plant morphological and biochemical traits, such as leaf texture, canopy structure, nutrient composition, and plant vigor, significantly affect aphid colonization and population growth (Amin *et al*. 2020). In Bangladesh, plant-derived and botanical products have been reported as environmentally safe alternatives to synthetic insecticides for managing major insect pests of country bean without adverse effects on crop growth (Ahmed *et al*. 2013). Subsequent field studies confirmed that plant-based powders, oils, and extracts effectively reduce aphid infestation and improve yield, supporting their suitability for eco-friendly pest management (Ahmed *et al*. 2019).

In addition to host plant resistance and botanicals, natural enemies play a critical role in regulating aphid populations. Predatory insects, including Coccinellids, Syrphids, Chrysopids, and parasitoids, exert strong top-down control on aphids (Mollah *et al.* 2012), and their abundance may vary among cultivars due to differences in plant architecture and habitat suitability (Costamagna and Landis 2006). Bio-rational pest management strategies have been shown to suppress major legume pests while conserving key natural enemies in yard long bean ecosystems (Mrong *et al*. 2024). Despite these benefits, farmers in Bangladesh commonly select country bean varieties based on market availability rather than pest resistance potential (Khan *et al*. 2018). Ecologically based pest management approaches are therefore increasingly recommended due to their effectiveness and compatibility with natural enemy conservation (Mrong *et al*. 2023). Integrated bio-rational pest management has been shown to reduce aphid and pod borer infestations while improving yield and profitability in yard long bean (Amin *et al*. 2016).

Therefore, understanding the interactions among plant characteristics, aphid infestation, natural enemy abundance, and yield performance across different cultivars is essential. The present study aims to evaluate aphid population abundance, infestation intensity, predator diversity, and yield performance of five country bean cultivars to support cultivar selection and ecologically based pest management strategies.

Materials and methods

The study was conducted from July 2022 to June 2023 at the field and laboratory of the Department of Entomology, Gazipur Agricultural University, Gazipur, Bangladesh. This area represents the Madhupur tract agro-ecological zone (AEZ-28) with silty clay loam to clay soils (pH 5.8-6.5) and a tropical climate. Five country bean varieties (BARI Bean 1, BARI Bean 5, BARI Bean 6, BARI Bean 7, and BARI Bean 10) were evaluated in a randomized complete block design with three replications and the plot size was 3 × 2 m. Seeds were soaked, sown and raised in polybags, and 14-day-old seedlings transplanted in the field. Fertilization (cow dung, N, P, K, S, and Zn), weeding, mulching, and irrigation was applied as needed. Weekly observations recorded vegetative and reproductive growth, while aphid and ladybird beetle populations were monitored on randomly selected plants. Leaf and fruit infestation percentages were calculated, and agronomic traits, trichome density, leaf pH, moisture content, protein, and chlorophyll a, b, total chlorophyll were measured following the methods stated by Afroz *et al*. (2022). Data were analyzed using one-way ANOVA with Tukey HSD, and relationships between plant traits and insect abundance were examined via correlation and multiple regression using SPSS 21.0.

Results and discussion

Varieties of the country bean showed clear variation in their developmental stages (Table 1). Significant differences were observed in branch initiation ($F_{4,10}$=22.7, p<0.001), inflorescence initiation ($F_{4,10}$=100.6, p<0.001), pod formation ($F_{4,10}$=254.8, p<0.001), fruit formation ($F_{4,10}$=269.5, p<0.001), and fruit harvesting maturity ($F_{4,10}$=177.2, p<0.001). Branch initiation was the longest in BARI Bean 5 (40±1.3 days after sowing), while BARI

Table 1. Variations in the duration (days after sowing) of the vegetative and reproductive development stages of the bean cultivars

Bean cultivars	Durations (days after sowing) for developmental changes				
	Branch initiation	Inflorescence initiation	Pod formation	Fruit formation	Fruit maturation
BARI Bean 1	34.8±1.6b	42±0.8c	48.2±0.2d	75.2±0.6c	98.2±0.3c
BARI Bean 5	40±1.3a	46.5±0.3b	53.±0.2b	64.3±0.4e	83.8±1.6e
BARI Bean 6	27±0.9c	44±0.8c	51.2±0.6c	85.2±0.7b	113.7±1.4b
BARI Bean 7	28.6±0.7c	48±0.3b	52.7±0.2bc	69.5±0.6d	91.3±1.2d
BARI Bean 10	30.5±0.6bc	55.5±0.0a	63±0.3a	93.7±1.1a	123.8±1.2a

Data expressed as (mean ± SE). Means within a row followed by same letter(s) are not significantly different according to Tukey Posthoc honestly significant difference test at $P \leq 0.05$.

Bean 1 (34.8±1.6 days after sowing) and BARI Bean 10 (30.5±0.6 days after sowing) required similar durations. The shortest period was recorded in BARI Bean 6 (27±0.9 days after sowing) and BARI Bean 7 (28.6±0.7 days after sowing). For inflorescence initiation, BARI Bean 10 took the maximum time (55.5±0.0 days after sowing), whereas BARI Bean 1 (42±0.8 days after sowing) and BARI Bean 6 (44±0.8 days after sowing) showed the earliest initiation. BARI Bean 5 (46.5±0.3 DAS) and BARI Bean 7 (48±0.3 days after sowing) performed similarly. Pod formation was also longest in BARI Bean 10 (63±0.3 days after sowing) and shortest in BARI Bean 1 (48.2±0.2 days after sowing). Fruit formation occurred fastest in BARI Bean 5 (64.3±0.4 days after sowing), followed by BARI Bean 7, BARI Bean 1, and BARI Bean 6, while BARI Bean 10 was the slowest (93.7±1.1 days after sowing). A similar trend was observed for fruit maturation, ranging from the shortest period in BARI Bean 5 (83.8±1.6 days after sowing) to the longest in BARI Bean 10 (123.8±1.2 days after sowing).

Different varieties of country bean differed significantly in their morphology, growth, and development (Table 2). Significant variation was recorded in plant height ($F_{4,10}$=29.1, $p<0.001$), stem diameter ($F_{4,10}$=22.2, $p<0.001$), internode length ($F_{4,10}$=18.5, $p<0.001$), number of nodes ($F_{4,10}$=72.3, $p<0.001$), leaf number per plant ($F_{4,10}$=9.7, $p<0.05$), leaf length ($F_{4,10}$=21.5, $p<0.001$), leaf width ($F_{4,10}$=18.9, $p<0.001$), and trichome density of both adaxial ($F_{4,20}$=37.2, $p<0.001$) and abaxial ($F_{4,20}$=10.5, $p<0.001$) leaf surfaces. BARI Bean 10 showed the greatest plant height (382.3±16.3 cm), followed by BARI Bean 7 and BARI Bean 6, whereas BARI Bean 5 was the shortest (49.6±4.5 cm). Stem diameter was also highest in BARI Bean 10 (8.3±0.2 mm), statistically similar to BARI Bean 6 (7.7±0.5 mm) and BARI Bean 7 (7.1±0.4 mm), while the lowest value occurred in BARI Bean 1 (4.1±0.1 mm). BARI Bean 7 produced the most branches (8.1±0.4), followed by BARI Bean 10 and BARI Bean 1, with BARI Bean 5 producing the fewest (2.1±0.4). Node number was highest in BARI Bean 10 (102±4.5), similar to BARI Bean 7 (83.5±6), and lowest in BARI Bean 5 (6±0.2). Internode length was longest in BARI Bean 7 and BARI Bean 10 (16.3±0.7 cm), similar to BARI Bean 6 and BARI Bean 1, and shortest in BARI Bean 5 (10.3±0.4 cm). Leaf number per plant was also greatest in BARI Bean 10 (179.5±28.4), statistically similar to BARI Bean 7, BARI Bean 6, and BARI Bean 1, while BARI Bean 5 had the minimum (36.8±3.3). BARI Bean 10 had the longest leaves (11.6±0.2 cm) and the widest leaves (10.1±0.2 cm), followed by BARI Bean 7 and BARI Bean 6, whereas BARI Bean 5 consistently produced the smallest leaves. Trichome density followed a similar trend, BARI Bean 10 had the highest density on both the adaxial (16.8 cm^2) and abaxial (21.6 cm^2) surfaces, similar to BARI Bean 6 and BARI Bean 7, while the lowest densities occurred in BARI Bean 5 (5.8 cm^2 adaxial; 12.4 cm^2 abaxial) and BARI Bean 1 (7.8 cm^2 adaxial). High trichome density acts as a physical barrier that restricts

Table 2. Variations in the morphological characteristics of the studied bean cultivars

Bean cultivars	Morphological characteristics								Number of trichomes	
	Plant height (cm)	Stem diameter (mm)	Branching plant^{-1}	No. of nodes plant^{-1}	Length of internode (cm)	Leaves plant^{-1}	Leaf length (cm)	Leaf width (cm)	Adaxial surface	Abaxial surface
BARI Bean 1	266.1±9.7b	5.5±0.2bc	6±1.3ab	67±4b	15.3±0.6a	165.6±19.5a	7.6±0.4b	6.2±0.6b	7.8±1.1c	14±1.3b
BARI Bean 5	49.6±4.5c	4.1±0.1c	2.1±0.4c	6±0.2c	10.3±0.4b	36.8±3.3b	5.7±0.1b	4.3±0.1b	5.8±1.2c	12.4±1.5b
BARI Bean 6	305.9±36.3ab	7.7±0.5a	3.6±0.9bc	81.3±5b	16±0.5a	167±22.6a	10.2±1a	8.9±1.0a	12.2±1.3b	19.4±1.5a
BARI Bean 7	321.6±33.03ab	7.1±0.4ab	8.1±0.4a	83.5±6ab	16.3±0.7a	176±13.2a	11.2±0.3a	9.8±0.4a	13.4±1.4b	19.6±1.6a
BARI Bean 10	382.3±16.3a	8.3±0.2a	7±0.3ab	102±4.5a	16.3±0.7a	179.5±28.4a	11.6±0.2a	10.1±0.2a	16.8±1.6a	21.6±1.7a

Data expressed as (mean ± SE). Means within a row followed by same letter(s) are not significantly different according to Tukey Posthoc honestly significant difference test at $P \leq 0.05$.

insect feeding, foraging, mating, and oviposition (Jayaraj and Uthamasamy 1990).

The phytochemical properties of the studied bean cultivars differed markedly across traits (Table 3). Significant variation was detected in moisture content of infested leaves ($F_{4,10} = 36.2$, $p < 0.001$), protein content in both fresh ($F_{4,10} = 13.7$, $p < 0.001$) and infested leaves ($F_{4,10} = 112.04$, $p < 0.001$), and leaf pH in fresh ($F_{4,20} = 5575.8$, $p < 0.001$) and infested conditions ($F_{4,20} = 220.3$, $p < 0.001$). Chlorophyll components also varied significantly among cultivars, including chlorophyll a (fresh: $F_{4,10} = 6.5$, $p < 0.05$; infested: $F_{4,10} = 17.6$, $p < 0.001$), chlorophyll b (fresh: $F_{4,10} = 51.03$, $p < 0.001$; infested: $F_{4,10} = 28.4$, $p < 0.001$), and total chlorophyll (fresh: $F_{4,10} = 16.6$, $p < 0.001$; infested: $F_{4,10} = 95.2$, $p < 0.001$). These results confirm substantial biochemical differentiation among the cultivars under both healthy and aphid-infested conditions.

In fresh leaves, protein content ranged from 20.3±0.4% in BARI Bean 6 to 23.3±0.1% in BARI Bean 7, while leaf pH varied between 6.4±0.004 in BARI Bean 5 and 7.2±0.006 in BARI Bean 6. Chlorophyll a was highest in BARI Bean 6 (0.6±0.04 mg g^{-1}) and lowest in BARI Bean 7 (0.4±0.01 mg g^{-1}), whereas chlorophyll b ranged from 0.3±0.01 mg g^{-1} in BARI Bean 7 to 0.7±0.02 mg g^{-1} in BARI Bean 6. Total chlorophyll also peaked in BARI Bean 6 (1.4±0.05 mg g^{-1}) and dropped to 0.8±0.02 mg g^{-1} in BARI Bean 7. Moisture content varied widely, from 57.4±1.9% in BARI Bean 5 to 77.6±0.3% in BARI Bean 10. Under aphid infestation, protein levels declined across all cultivars, ranging from 16.1±0.2% in BARI Bean 5 to 20.6±0.1% in BARI Bean 7. Infested-leaf pH showed cultivar-specific shifts, from 1.7±0.05 in BARI Bean 5 to 3.5±0.04 in BARI Bean 7. Chlorophyll a decreased to values between 0.2±0.02 mg g^{-1} (BARI Bean 5) and 0.4±0.02 mg g^{-1} (BARI Bean 7), while chlorophyll b fell to 0.12±0.003 mg g^{-1} in BARI Bean 5 and reached its highest level in BARI Bean 7 (0.29±0.01 mg g^{-1}). Total chlorophyll was lowest in BARI Bean 5 (0.32±0.02 mg g^{-1}) and highest in BARI Bean 7 (0.77±0.02 mg g^{-1}). Overall, BARI Bean 6 and BARI Bean 7 showed stronger retention of pigments and protein, whereas BARI Bean 5 was the most adversely affected by aphid infestation. Aphids extract amino acids directly from phloem sap to meet their nitrogen requirements, which can lead to a reduction in protein content in the host plant (Douglas 2003). Similarly, Ojmelukwe *et al*. (1999) reported that infestation by pulse

Table 3. Phytochemical properties of fresh and aphid infested leaves of the studied bean cultivars

Bean cultivars	Phytochemical properties										
	Fresh leaf					Infested leaf					
	Protein content (%)	pH value	Chlorophyl a (mg g^{-1})	Chlorophyl b (mg g^{-1})	Total chlorophyll (mg g^{-1})	Moisture (%)	Protein content (%)	pH value	Chlorophyl a (mg g^{-1})	Chlorophyl b (mg g^{-1})	Total chlorophyll (mg g^{-1})
BARI Bean 1	21.7±0.2bc	6.6±0.003b	0.5±0.06ab	0.5±0.03c	1.01±0.1bc	76.0±1.5a	19.1±0.3b	2.2±0.05d	0.3±0.02ab	0.17±0.02bc	0.52±0.02b
BARI Bean 5	21.9±0.5ab	6.4±0.004d	0.5±0.02ab	0.6±0.03b	1.2±0.1ab	57.4±1.9c	16.1±0.2d	1.7±0.05e	0.2±0.02c	0.12±0.003c	0.32±0.02c
BARI Bean 6	20.3±0.4c	7.2±0.006a	0.6±0.04a	0.7±0.02a	1.4±0.05a	74.1±1.6ab	17.6±0.1c	2.6±0.06c	0.3±0.01b	0.19±0.01b	0.53±0.01b
BARI Bean 7	23.3±0.1a	6.6±0.004c	0.4±0.01b	0.3±0.01d	0.8±0.02c	67.9±1b	20.6±0.1a	3.5±0.04a	0.4±0.02a	0.29±0.01a	0.77±0.02a
BARI Bean 10	20.7±0.4bc	6.6±0.002b	0.5±0.01a	0.4±0.01c	1±0.02bc	77.6±0.3a	19.3±0.3b	3.1±0.04b	0.3±0.01b	0.22±0.01b	0.57±0.01b

Data expressed as (mean ± SE). Means within a row followed by same letter(s) are not significantly different according to Tukey Posthoc honestly significant difference test at $P \leq 0.05$.

beetle (*Callosobruchus maculatus*) caused depletion of protein, starch, and soluble sugars in cowpea seeds. In addition, Wooly apple aphid (*Eriosoma lanigerum*) feeding on Fuji apple twigs significantly reduced soluble sugar, protein, and amino acid levels (Zhou *et al*. 2013). These studies collectively demonstrate that insect feeding injury not only damages plant tissues physically but also disrupts nutrient composition and impairs physiological processes, ultimately affecting plant growth and productivity.

Aphid population abundance during November 2022 to January 2023 on the tested varieties showed fluctuations (Figure 1). It increased rapidly from the third week to fourth week of November and reached to the peak (21.2 leaf^{-1}) on BARI Bean 5 (9.2±2.3) and the lowest abundance was found on BARI Bean 1 (2.8±0.8). After that, the aphid population declined rapidly in the second week of December 2022 to January 2023. Mollah and Khatun (2024) observed that cotton aphid (*Aphis gossypii*) also showed fluctuation in infestation in brinjal field.

Figure 2 showed mean abundance of aphid on the country bean varieties ranged from 2.8±0.8 to 9.2±2.3 leaf^{-1}, and the results differed significantly ($F_{4, 40} = 2.3$, $p< 0.05$). Among the tested varieties, BARI Bean 5 and BARI Bean 1 revealed significantly highest and lowest number of aphid population compared to other varieties, respectively. Amjad *et al*. (2009) tested five cotton cultivars against whitefly, thrips, jassid and aphid and showed significant variations in population abundance of the pests on different varieties. Amin *et al*. (2017) found mean abundance of aphid on the cotton varieties ranged from 4.3±0.4 to 6.4±0.7 leaf^{-1} and the results were significantly differed ($F_{4,250}= 2.9$, $p< 0.05$).

A total of six natural enemies of aphids, representing five orders (Coleoptera, Neuroptera, Diptera, Hemiptera, Hymenoptera), were recorded on five country bean cultivars (Table 4). The abundance of ladybird beetle differed significantly ($F_{4,25}=4.05$, $p<0.05$), being highest on BARI Bean 5 (4.3±0.6) and lowest on BARI Bean 10 (1.3±0.4), similar to BARI Bean 1 (1.5±0.6). Parasitic wasps also varied significantly ($F_{4,25}=6.84$, $p\leq0.001$), with the greatest numbers on BARI Bean 5 (5.8±0.9) and lowest on BARI Bean 1 and 10 (0.8±0.3), comparable to BARI Bean 7. In contrast, the abundance of green lacewings did not differ significantly ($F_{4,25}=1.43$, $p>0.05$). Syrphid flies showed significant variation ($F_{4,25}=18.8$, $p\leq0.001$), peaking on BARI Bean 6 (4.5±0.4) and lowest on BARI Bean 5 (0.2±0.2). Damsel bugs ($F_{4,25}=6.8$, $p\leq0.001$) were most abundant on BARI Bean 6 (3±0.6) and

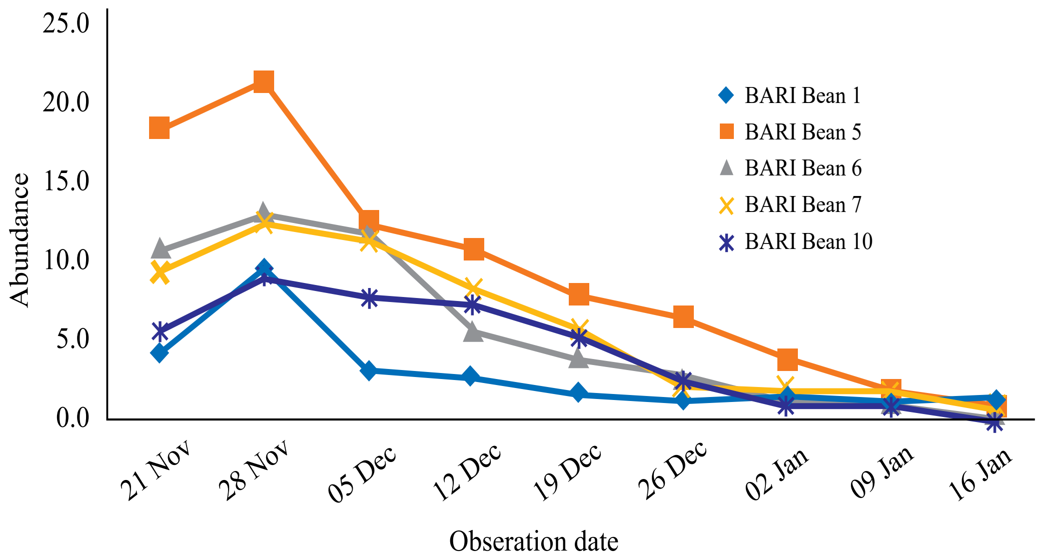

Figure 1. Fluctuation of aphid abundance (number leaf^{-1}) on five different bean cultivars during November 2022 to January 2023.

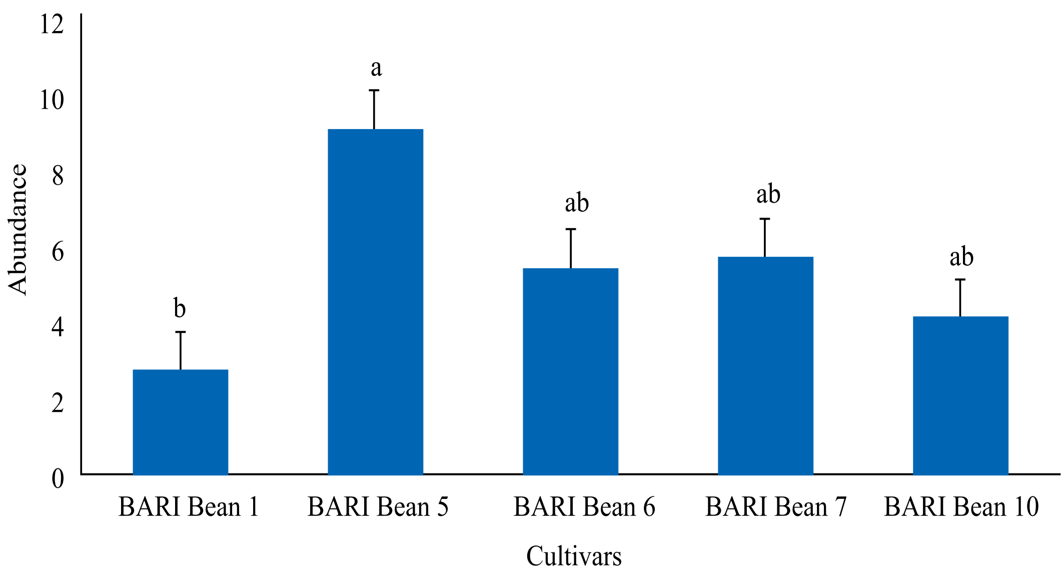

Figure 2. Abundance of aphid (number leaf^{-1}) (mean ± SE) on five cultivars of bean during November 2022 to January 2023. Means within a bar followed by same letter(s) are not significantly different according to Tukey posthoc honestly significant different test at P ≤ 0.05.

Table 4. Abundance of predators on the studied bean cultivars

Bean cultivars	Predators and Orders					
	Ladybird beetle (Coleoptera)	Parasitic wasp (Hymenoptera)	Green lacewings (Neuroptera)	Syrphid fly (Diptera)	Damsel bug (Hemiptera)	Big eyed bug (Hemiptera)
BARI Bean 1	1.5±0.6b	0.8±0.3b	0.5±0.2a	3±0.3a	0.3±0.2b	0.3±0.2b
BARI Bean 5	4.3±0.6a	5.8±0.9a	1±0.4a	0.2±0.2b	1±0.4b	1.7±0.4ab
BARI Bean 6	3±0.8ab	4±1.5ab	1.2±0.3a	4.5±0.4a	3±0.6a	2.3±0.6a
BARI Bean 7	1.8±0.6ab	2.3±0.6b	0.8±0.3a	1.2±0.5b	1.2±0.3b	1.2±0.7ab
BARI Bean 10	1.3±0.4b	0.8±0.3b	0.3±0.2a	3±0.5a	0.8±0.3b	0.5±0.2ab

Data expressed as (mean ± SE). Means within a row followed by same letter(s) are not significantly different according to Tukey Posthoc honestly significant difference test at $P \leq 0.05$.

least on BARI Bean 1 (0.3±0.2), while big-eyed bugs differed significantly ($F_{4,25}$=3.4, $p<0.05$), highest on BARI Bean 6 (2.3±0.6) and lowest on BARI Bean 1 (0.3±0.2). Overall, BARI Bean 5 supported the highest abundance of ladybird beetles and parasitic wasps and was the most heavily infested cultivar with aphids.

The leaf infestation (%) of different varieties of country bean in different times of the growing period showed significant differences ($F_{4,40}$=3.4, $p<0.05$). The highest percentage of leaf infestation was observed on BARI Bean 5 (11.6±3.4 %) and the lowest percentage was found on BARI Bean 10 (2.7±0.9 %). BARI Bean 1, BARI Bean 6 and BARI Bean 7 showed statistically similar results (3.6±1.3, 8.7±2.6 and 3.6±1.3, respectively) (Figure 3).

The fruit infestation (%) of different cultivars of country bean in different times of the fruiting period showed significant differences ($F_{4,35}$=7.5, $p<0.001$) (Figure 4). The highest percentage of fruit infestation was observed on BARI Bean 5 (22.5±3.7 %). The lowest percentage of fruit infestation was observed on BARI Bean 6 (5.6±1.3 %) which was statistically similar with BARI Bean 10 (6.9±2.1 %), BARI Bean 1 (10.9±2.4 %), BARI Bean 7 (12.1±1.8 %), respectively. The fruit infestation was at the peak during first week of January and then declined gradually at the mid-February before harvesting.

Significant variation was observed among the country bean cultivars in fruit length ($F_{4,45}$=177.2, $p<0.001$), fruit width ($F_{4,45}$=84.6, $p<0.001$), total fruits per plot ($F_{4,10}$=9.7, $p<0.05$), seeds per fruit ($F_{4,10}$=10.2, $p<0.05$), 100-seed weight ($F_{4,10}$=229.2, $p<0.001$), and yield ($F_{4,10}$=3.3, $p<0.05$) (Table 5). BARI Bean 6 had the longest fruits (20.2±0.5 cm) and most seeds per fruit (6.0±0.6), while BARI Bean 5 had the shortest fruits (7.8±0.3 cm) and fewest seeds (2.7±0.3). BARI Bean 10 produced the widest fruits (2.83±0.05 cm) and heaviest seeds (53.9±0.5 g), achieving the highest yield (0.2±0.05 tha^{-1}), whereas BARI Bean 5 had the lowest yield (0.01±0.03 tha^{-1}).

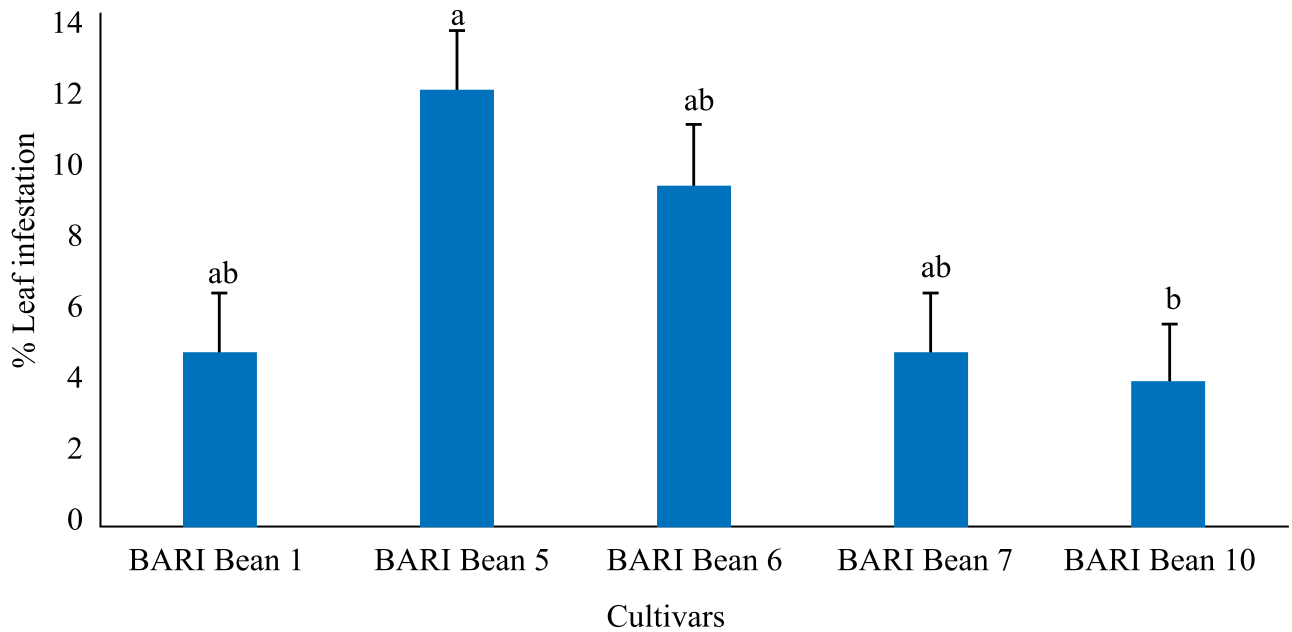

Figure 3. Leaf infestation level of aphid (% mean ± SE) on five bean cultivars during November 2022 to January 2023. Means within a bar followed by same letter(s) are not significantly different according to Tukey Posthoc honestly significant different test at P ≤ 0.05.

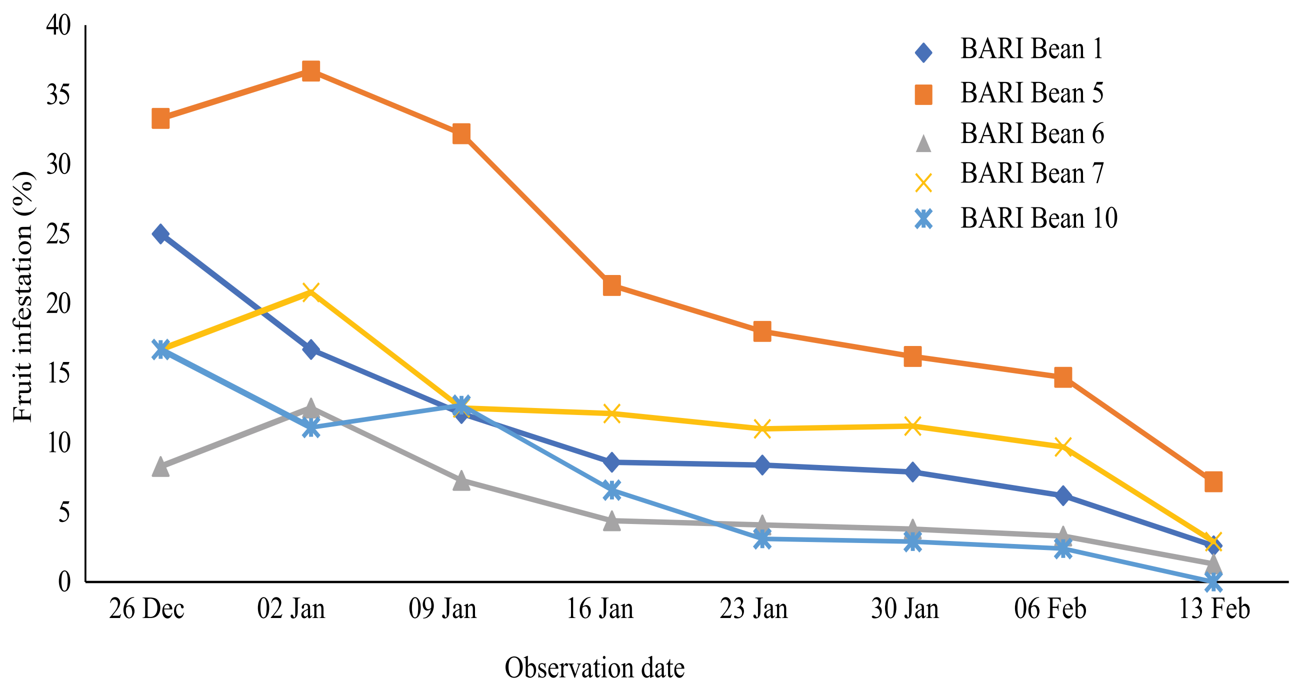

Figure 4. Fruit infestation level of aphid (% mean±SE) on five bean cultivars during November 2022 to February 2023.

Table 5. Variations in the yield contributing characteristics and yield of the studied bean cultivars

Bean cultivars	Yield contributing characteristics					
	Fruit length (cm)	Fruit width (cm)	Total number of fruit plot^{-1}	Number of seed per fruit	Seed weight (100 seed) (gm)	Yield (tha^{-1})
BARI Bean 1	9.8±0.3b	1.8±0.08b	79.6±14.5a	3.3±0.3b	23.3±1.5e	0.1±0.05ab
BARI Bean 5	7.8±0.3c	2.0±0.05b	25±6c	2.7±0.3b	31.2±0.6d	0.01±0.03b
BARI Bean 6	20.2±0.5a	1.4±0.07c	60.7±5ab	6.0±0.6a	42.0±0.3b	0.1±0.05ab
BARI Bean 7	9.8±0.3b	2.81±0.06a	40.3±5bc	4.33±0.3ab	37.8±0.3c	0.1±0.04ab
BARI Bean 10	10.4±0.4b	2.83±0.05a	76.67±1.5a	4.33±0.3ab	53.9±0.5a	0.2±0.05a

Data expressed as (mean ± SE). Means within a row followed by same letter(s) are not significantly different according to Tukey Posthoc honestly significant difference test at $P \leq 0.05$.

Conclusion

BARI Bean 10, with low aphid abundance, minimal leaf and fruit infestation, and the highest yield parameters, can be recommended for country bean growers. BARI Bean 5 was the most susceptible cultivar, with the highest aphid population, leaf and fruit damage, and the lowest yield. However, BARI Bean 6 and BARI Bean 7 also performed well, showing moderate aphid infestation, good predator balance, and satisfactory growth and yield traits. These findings highlight the importance of selecting cultivars with inherent resistance traits and favorable morphological and biochemical characteristics to reduce aphid damage and enhance productivity. Integrating such resistant cultivars with natural predator conservation can provide an effective and sustainable approach for country bean production in Bangladesh.

Acknowledgement

The authors extend their cordial appreciation to the Ministry of Science and Technology, Government of the People's Republic of Bangladesh for funding support.

References

Afroz M, Miah MRU, Hossain MM and Amin MR. 2022. Physico-chemical leaf attributes of sweet gourd influence the infestation of red pumpkin beetle. Journal of Entomological Research. 46: 440-445.

Ahmed MT, Miah MRU, Amin MR and Hossain MM. 2015. Evaluation of some plant materials against pod borer infestation in country bean with reference to flower production. Annals of Bangladesh Agricultural. 19: 71-78.

Ahmed MT, Miah MRU, Amin MR, Hossain MM, Suh SJ and Kwon YJ. 2019. Plant material as an alternative tool for management of aphid in country bean field, International Journal of Pest Management. 65: 171-176.

Amin MR, Afrin R, Alam MZ, Hossain MM and kwon YJ. 2017. Effect of leaf trichomes and meteorological parameters on population dynamics of aphid and jassid in cotton. Bangladesh Journal of Agricultural Research. 42: 13-25.

Amin MR, Sharmin MA, Miah MRU, Akanda AM, Suh SJ, Kwon YJ and Kwon O. 2020. Aphid population abundance and pestiferous effect on various bean plant species. Entomological Research. 50: 257-266.

Amin MR, Tarif AA, Rahman MM, Hossain MM and Ge F. 2017. Sequential application of bio-pesticide, botanical and chemical insecticide to manage aphid and pod borer attacking yard long bean. Bangladesh Journal of Agricultural Research. 42: 531-538.

Amjad M, Bashir MH and Afzal M. 2009. Comparative resistance of some cotton cultivars against sucking insect pests. Pakistan Journal of Life and Social Sciences. 7: 144-147.

BBS (Bangladesh Bureau of Statistics). 2020. Yearbook of Agricultural Statistics of Bangladesh. Ministry of Planning, Dhaka, Bangladesh.

Chopkar PS, Desai VS, Samrit RM, Uparkar AL, Choudhari RJ and Shelke SB. 2020. Effect of border crops on pest population in Lablab bean (*Lablab purpureus* L.). Journal of Entomology and Zoology Studies. 8: 1407-1412.

Chowdhury MGF, Rahman MA, Miaruddin M, Khan MHH and Rahman MM. 2019. Assessment of pesticides and ripening chemicals used in selected vegetables at different locations of Bangladesh. Bangladesh Journal of Agricultural Research. 44: 261-279.

Costamagna AC and Landis DA. 2006. Predators exert top-down control of soybean aphid across a gradient of agricultural management systems. Ecological Applications. 16: 1619-1628.

Douglas AE, Francois CLMJ and Minto LB. 2006. Facultative 'secondary' bacterial symbionts and the nutrition of the pea aphid, *Acyrthosiphon pisum*. Physiological Entomology. 31: 262-269.

Jayaraj and Uthamasamy S. 1990. Aspects of insect resistance in crop plants. Proceedings of the Indian Academy of Sciences. 99: 211-224.

Khan AU, Choudhury MAR, Islam MS and Maleque MA. 2018. Abundance and fluctuation patterns of insect pests in country bean. Journal of Sylhet Agricultural University. 5: 167-172.

Malik YP, Ram S and Singh SV. 1988. Seasonal variation in the population of various insect pests of bean (*Dolichos labial* Linn.) Science Citation Index Journal. 3: 202-204.

Mollah MMI, Rahman MM, Khatun S and Mala M. 2017. Insect pest complex of year-round country bean (*Lablab purpureus* L.) during the summer season. SCIREA Journal of Agriculture. 1: 186-196.

Mollah MMI, Rahman MM, Alam MZ and Hossain MM. 2013. Yield performance of heat tolerant country bean (*Lablab Purpureus* Lin.) as influenced by insecticides during kharif season. Journal of Entomology and Zoology Studies. 1: 1-6.

Mollah MMI, Rahman MM, Amin MR, Khatun S and Shahadat MK. 2022. Evaluation of insecticides against bean bug and jute hairy caterpillar infesting country bean. Ecology Journal. 4: 111-114.

Mollah MMI, Rahman MM, Miah MA, Mala M and Hassan MZ. 2013. Efficacy of insecticides on the incidence and infestation of lablab bean aphid (*Aphis craccivora* Koch) under field conditions. Journal of Patuakhali Science and Technology University. 4: 53-59.

Mollah MMI, Rahman MM and Alam MZ. 2012. Toxic effect of some insecticides on predatory lady bird beetles (Coleoptera: Coccinellidae) in country bean (*Lablab purpureus* L.) field. World Journal of Zoology. 7: 347-350. DOI: 10.5829/idosi.wjz.2012.7.4.7117.

Mollah MMI and Khatun S. 2024. Exploring selected bioinsecticides for management of cotton aphids (*Aphis gossypii* Glover) of brinjal in Bangladesh. Journal of Agriculture and Food Research 18: 101289. https://doi.org/10.1016/j.jafr.2024.101289.

Mrong A, Amin MR, Kayesh E, Sutradhar P and Hossain MS. 2024. Effectiveness of bio-rational insecticides against pod borer of yard long bean and their effect on natural enemies. Annals of Bangladesh Agriculture. 28: 39-47.

Mrong A, Samiha A, Amin MR, Kayesh E and Hossain MS. 2023. Effect of different bio-rational insecticides on the infestation of pod borer attacking yard long bean. Ecology Journal. 5: 67-72.

Ojimelukwe PC, Onweluzo JC and Okechykwu E. 1999. Effects of infestation on the nutrient content and physicochemical properties of two cowpea (*Vigna unguiculata*) varieties. Plant Foods for Human Nutrition. 53: 321- 332.

Rahman MM, Hasan MM, Hannan A, Dev S and Mondal MF. 2022. Farmers' perceptions and knowledge of country bean (*lablab purpureus* l.) insect pests, and diseases, and their management practices in Bangladesh. Sustainability. 20: 13591.

Verma P and Gupta UP. 2010. Immunological detection of bean common mosaic virus in French bean (*Phaseolus vulgaris* L.) leaves. Indian Journal of Microbiology. 50: 263-265.

Zhou HX, Wang XC, Yu Y, Tan XM, Cheng ZQ, Zhang AS and Li LL. 2013. Chemical characteristics of normal, woolly apple aphid- damaged, and mechanically damaged twigs of six apple cultivars, measured in autumn wood. Journal of Economic Entomology. 106: 1011-1017.