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Growth and Yield Performance of Snap Beans (*Phaseolus vulgaris* L.) as Affected by Salt-Based and Molasses-Based JADAM Liquid Fertilizers Using Selected Plant Material Sources

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Abstract— *This study evaluated the effects of JADAM Liquid Fertilizer (JLF), specifically molasses-based and salt-based formulations, using different plant material sources on the growth, yield, and profitability of snap beans. The experiment was conducted from April to July 2025 at the Vegetable Production Area of Bataan Peninsula State University – Abucay Campus, Bangkal, Abucay, Bataan. A split-plot design following the Randomized Complete Block Design was used, with two JLF formulations as the main plot treatments and three plant material sources (weed, banana trunk, and their combination) as the sub-plot treatments. The experiment was replicated three times.*

Results showed that while most growth and yield parameters did not differ significantly among treatments, the molasses-based JADAM liquid fertilizer showed numerical advantages over the salt-based formulation in plant height, flowering, and yield-related traits. A significant interaction (P < 0.01) was observed for days to flowering, with molasses-based JLF combined with weed or weed+banana trunk producing the earliest flowering. Among the plant material sources, the banana trunk and the combination of weed and banana trunk produced numerically competitive results. Among treatment combinations, molasses-based JLF combined with banana trunk (J1S2) yielded the highest gross income, net income, and return on investment, making it the most profitable option based on observed trends. Therefore, the use of molasses-based JADAM liquid fertilizer with banana trunk is recommended as a cost-efficient and sustainable fertilizer option for snap bean production, noting that most treatments were statistically comparable in agronomic performance.

Keywords— Growth, JADAM Liquid Fertilizer, Molasses, Plant Material Sources, Snap Beans, Yield.

I. INTRODUCTION

Vegetables and fruits are highly recommended in diets for their nutritional value. Among these, leguminous vegetables are particularly important for low-income countries because of their protein and mineral content, and their potential to increase food security and income [1]. The snap bean (*Phaseolus vulgaris* L.), also known as French bean or green bean, is a legume crop believed to have originated in Latin American countries. It can be grown as a vegetable crop for fresh pods or as a pulse crop for dry seed [2]. Globally, snap beans are considered one of the most important legume vegetable crops, and they contribute a substantial amount of protein to the human diet [2].

In 2019, the global harvested area for snap beans was 33.1 million hectares, with a production of 28.9 million tons [4]. Snap beans are produced mainly in Asia, America, Europe, and Africa [5], [6]. In the Philippines, snap beans, locally known as "habichuelas" or "Baguio beans," are generally cultivated in upland and highland areas. It is recognized as a priority crop by the Department of Agriculture [7]. In 2020, production reached 13,420.83 metric tons, cultivated on 2,974.44 hectares. The Cordillera Administrative Region remains the major producer of snap beans, contributing about 50% of national snap bean production over the past five years [8]. Farmers in these areas consider it an important cash crop and an additional source of income [9], particularly for smallholders and the marginalized.

Conversely, with the soaring costs of farm inputs, mainly fertilizers, farmers are compelled to take risks to sustain production, often resulting in low profits or losses. In addition, the excessive and repetitive use of synthetic fertilizers over time poses risks, including environmental harm, reduced soil fertility, and negative impacts on farmers' health [10]. In the quest for sustainable, cost-effective, and eco-friendly farming practices, organic liquid fertilizers have emerged as a popular alternative to synthetic chemical fertilizers [11].

One such organic liquid fertilizer that is gradually becoming known in the realm of organic farming is JADAM liquid fertilizer (JLF). As a key component of JADAM organic farming, JLF is a versatile fertilizer derived from organic materials via an anaerobic fermentation process known as putrefaction [12]. It can be applied at various stages of plant growth and has been shown to enhance soil microbial activity, increase nutrient availability, and stimulate plant growth. This liquid fertilizer, made from crop residues and wild grass materials, has a balance of N, P, K, Ca, Mg, and other nutrients that crops need [13], thereby reducing farmers' reliance on expensive inputs.

The effectiveness of this liquid fertilizer critically depends on the organic materials used in the fermentation process. Plant materials such as Singapore daisy (*Sphagneticola trilobata*, syn. *Wedelia trilobata*) and banana trunks are suitable for preparing JADAM liquid fertilizer due to their nutrient content and availability. *Sphagneticola trilobata*, commonly known as Singapore daisy or trailing daisy, is an invasive weed used to restore soil fertility and is usually utilized as ground cover, capable of improving soil quality ecologically. Setyowati reported that this weed has high potential as an organic fertilizer owing to its high nitrogen content and its abundant populations around agricultural areas or in uncultivated lands [14]. Similarly, banana trunks, often regarded as agricultural waste, contain appreciable amounts of macronutrients and micronutrients, making them suitable for composting, mulching, and the production of organic fertilizers [15]. Meanwhile, molasses, a carbon-rich substrate, is commonly integrated in the preparation of liquid organic fertilizer. Its natural sugars feed the microbes responsible for fermentation, improving the effectiveness of organic inputs such as plant materials [16].

JADAM liquid fertilizer has been promoted as a low-cost alternative, yet limited empirical studies have evaluated its efficacy on leguminous vegetables, such as snap beans. Furthermore, the comparative effects of molasses as an additive to JADAM liquid fertilizer, as well as the optimal plant material source for JLF preparation under Philippine conditions, remain largely unexplored.

II. MATERIALS AND METHODS

2.1 Experimental Site and Crop:

The experiment was conducted at the Vegetable Production Area of Bataan Peninsula State University-Abucay Campus, Bangkal, Abucay, Bataan. The site had a gently sloping topography and received sufficient sunlight for snap bean growth. The soil was predominantly Antipolo clay soil. Based on rapid soil testing, the soil was low in nitrogen but high in phosphorus and potassium, with a pH of 5.8. The Mayabong pole snap bean variety was used. This variety produces green pods, grows as a climbing type, and can be harvested about 45 to 50 days after sowing under favorable conditions.

2.2 Experimental Design and Treatments:

The study was laid out in a split-plot design following the Randomized Complete Block Design with three replications. The two JLF formulations served as the main plot treatments, while the plant material sources served as subplot treatments. Each plot measured 2.5 m × 3.5 m and contained four rows. The treatment structure is summarized below.

TABLE A
TREATMENT FACTORS AND CODES USED IN THE EXPERIMENT

Factor	Code	Treatment description
Main plot: JLF formulation	J1	Molasses-based JADAM liquid fertilizer
Main plot: JLF formulation	J2	Salt-based JADAM liquid fertilizer or JLF without molasses
Subplot: plant material source	S1	Weed (Singapore daisy)
Subplot: plant material source	S2	Banana trunk
Subplot: plant material source	S3	Weed + banana trunk

Note: J1 and J2 are main plot treatments; S1, S2, and S3 are subplot treatments.

2.3 Preparation and Application of JADAM Liquid Fertilizer:

The JLF treatments were prepared using 1 kg of weed, 1 kg of banana trunk, or a 500 g + 500 g combination (weed + banana trunk). The salt-based formulation used 15 L of unchlorinated water, 90 g of leaf mold soil, and 30 g of rock salt. The molasses-based formulation used the same amount of water and leaf mold soil, but used 1 L of molasses instead of rock salt. The plant materials were chopped into small pieces, placed in clean containers, mixed thoroughly with leaf mold soil and the required additive, covered, and fermented for 30 days. The mixture was stirred every three days.

Treatments were applied as a drench at a rate of 10 mL JLF diluted in 1 L of water. The solution was poured around the base of the plant using a watering can. Application was done twice a week, beginning two weeks after seed emergence and continuing until fruit setting. Applications were made early in the morning or late in the afternoon to reduce stress on the plants.

2.4 Crop Management and Data Collection:

Land preparation included clearing, plowing, harrowing, and incorporation of decomposed animal manure. Seeds were sown at a depth of about 2 cm, with 30 cm between hills and 75 cm between rows. Thinning was done two weeks after emergence, leaving the healthiest plant. Trellising, hilling up, manual weeding, irrigation, pest monitoring, deleafing, harvesting, and postharvest sorting were done as needed. Pods were harvested by hand every 3 to 5 days when they reached an acceptable market size and quality.

Growth data included plant height at harvest, days to flowering, and number of lateral branches. Yield and yield components included the number of pods per plant, pod length, pod diameter, pod weight, fresh pod weight per plant, computed yield per hectare, and cost and return analysis. Data were analyzed using analysis of variance for split-plot RCBD. Differences among means were compared using the Least Significant Difference (LSD) test at the 5% level of significance.

III. RESULTS AND DISCUSSION

3.1 General Field Observations:

During the early phase of the experiment, high temperature and intense sunlight affected seed germination and seedling establishment. Resowing and frequent irrigation were done to reduce heat stress. During the flowering and pod-setting stages, strong winds and rainfall caused some flower shedding and occasional lodging. Drainage canals and hilling up were used to reduce waterlogging, root stress, and lodging.

Several pests were observed during the cropping period. Bean leaf beetle attacked the plants during the vegetative stage, while milkweed bug, stink bug, bean leaf beetle, bean pod borer, and cowpea curculio were observed during flowering and pod production. Bacterial blight was also observed on some pods, but only to a limited extent. Pest and disease management included handpicking, sticky traps, field sanitation, deleafing, removal of damaged plant parts, and one insecticide application when the pest population increased.

3.2 Growth Performance:

3.2.1 Plant Height:

Table 1 presents the average height of sample plants at harvest. Plant height ranged from 262.83 cm (J1S2) to 308.80 cm (J1S1). Analysis of variance revealed no significant differences among JLF formulations, material sources, or their interaction for plant height at harvest. Numerically, plants treated with molasses-based JLF (J1, 286.47 cm) were taller than those treated with salt-based JLF (J2, 272.60 cm). Among material sources, weed alone (S1, 289.59 cm) produced the tallest plants numerically, followed by the combination treatment (S3, 280.27 cm), while banana trunk alone (S2, 268.75 cm) produced the shortest.

Although the differences were not statistically significant, the numerical advantage of J1 and S1 suggests that the molasses-based formulation and Singapore daisy material may provide a favorable nutrient and microbial environment for vegetative growth. Pyakurel et al. [17] reported that molasses combined with organic fertilizer improved soil organic carbon, nitrogen, and spinach yield, while Al-Dhumri et al. [18] found that molasses application increased the availability of N, P, K, organic matter, calcium, and magnesium in soil. Studies on *Sphagneticola trilobata* also support the better numerical performance of the weed-based material. Suci et al. [19] reported that *S. trilobata* compost improved soil chemical properties and significantly increased sweet corn height, leaf number, stem diameter, and leaf area. Similarly, Setyowati et al. [14] found that weed-based compost improved the growth and yield of chili pepper, and Muktamar et al. [20] reported that *Wedelia* compost improved total N, available P, exchangeable K, Ca, and Mg, as well as soil pH, in acidic soils.

3.2.2 Days to Flowering:

Table 1 presents the average number of days to flowering. Plants treated with molasses-based JLF (J1, 36.89 DAS) flowered numerically earlier than those treated with salt-based JLF (J2, 38.11 DAS). Among material sources, weed alone (S1, 37.33 DAS) and weed+banana trunk (S3, 37.33 DAS) showed numerically earlier flowering than banana trunk alone (S2, 37.84 DAS).

The analysis of variance showed a highly significant interaction ($P < 0.01$) between JLF formulation and plant material source for days to flowering (Table 1a). This indicates that flowering response depended on the specific combination of JLF type and plant material source rather than on either factor alone. The earliest flowering was observed in J1S1 (molasses-based JLF + weed) and J1S3 (molasses-based JLF + weed+banana trunk), both at 36.33 DAS, followed by J2S2 (salt-based JLF + banana trunk) at 37.67 DAS. The longest flowering time was recorded in J2S1 and J2S3 (38.33 DAS).

The early flowering in J1S1 and J1S3 suggests that molasses-based JLF was more effective when combined with weed-based material. This may be related to molasses' role as a readily available carbon source that stimulates microbial activity and nutrient mineralization. Pyakurel et al. [17] and Al-Dhumri et al. [18] both reported improvements in soil nutrient availability following molasses application, while Suci et al. [19] and Muktamar et al. [20] showed that *S. trilobata* or *Wedelia*-based compost can improve soil fertility. The results also suggest that banana trunk alone did not promote early flowering as consistently as weed-based materials when combined with molasses-based JLF.

TABLE 1

PLANT HEIGHT, DAYS TO FLOWERING, AND LATERAL BRANCHES OF SNAP BEANS APPLIED WITH SALT-BASED AND MOLASSES-BASED JLF USING DIFFERENT PLANT MATERIAL SOURCES

Code	Description	Plant height (cm)	Days to flowering	Lateral branches
J1	JLF with molasses	286.47 a	36.89 a	17.76 a
J2	JLF without molasses	272.60 a	38.11 a	16.49 a
S1	Weed	289.59 a	37.33 a	16.92 a
S2	Banana trunk	268.75 a	37.84 a	18.65 a
S3	Weed + banana trunk	280.27 a	37.33 a	15.80 a
J1S1	JLF with molasses + weed	308.80 a	36.33 a	19.27 a
J1S2	JLF with molasses + banana trunk	262.83 a	38.00 bc	17.30 a
J1S3	JLF with molasses + weed + banana trunk	287.77 a	36.33 a	16.70 a
J2S1	JLF without molasses + weed	270.37 a	38.33 c	14.57 a
J2S2	JLF without molasses + banana trunk	274.67 a	37.67 b	20.00 a
J2S3	JLF without molasses + weed + banana trunk	272.77 a	38.33 c	14.90 a
F-test	Main plot	ns	ns	ns
F-test	Subplot	ns	ns	ns
F-test	A × B	ns	**	ns
CV%	Main plot (JLF)	9.25	2.27	2.16
CV%	Subplot (materials)	8.34	1.18	1.39

Note: Means with the same letter are not significantly different from each other (LSD, P < 0.05). ns = not significant; ** = significant at P < 0.01.

TABLE 1 (A)

COMPARISON OF SUBPLOTS AT EACH LEVEL OF THE MAIN PLOT FOR DAYS TO FLOWERING

Material source	J1: molasses-based JLF	J2: salt-based JLF
S1: Weed	36.33 a	38.33 c
S2: Banana trunk	38.00 bc	37.67 b
S3: Weed + banana trunk	36.33 a	38.33 c

Note: Means with the same letter are not significantly different from each other (LSD, P < 0.05).

3.2.3 Lateral Branches

Table 1 presents the average number of lateral branches per sample plant. Plants treated with molasses-based JLF (J1, 17.76) produced numerically more branches than those treated with salt-based JLF (J2, 16.49). Among material sources, banana trunk alone (S2, 18.65) obtained the highest number of lateral branches numerically. No significant differences were found for lateral branching; therefore, the observed differences should be interpreted as numerical trends only.

3.3 Yield and Yield Components

3.3.1 Pod Length, Pod Diameter, and Pod Weight

Table 2 presents pod length, pod diameter, and pod weight. Analysis of variance showed no significant treatment effects on any of these parameters. Pod length ranged from 15.04 cm to 15.30 cm across treatment combinations. Pod diameter ranged from 8.87 mm to 9.05 mm. Pod weight ranged from 8.44 g to 9.13 g.

The uniform pod characteristics across treatments suggest that pod quality traits may be less responsive to the tested fertilizer treatments than vegetative growth or flowering. Beshir et al. [3] reported that snap bean pod quality is influenced by cultivar, climate zone, and nitrogen fixation, indicating that pod traits may depend on multiple genetic and environmental factors beyond the fertilizer source. Singh et al. [25] also emphasized that nitrogen fertilization responses in snap beans depend on cropping conditions and soil nutrient status.

TABLE 2
POD LENGTH, POD DIAMETER, AND POD WEIGHT OF SNAP BEANS APPLIED WITH SALT-BASED AND MOLASSES-BASED JLF USING DIFFERENT PLANT MATERIAL SOURCES

Code	Description	Pod length (cm)	Pod diameter (mm)	Pod weight (g)
J1	JLF with molasses	15.21 a	8.98 a	8.85 a
J2	JLF without molasses	15.07 a	8.97 a	9.01 a
S1	Weed	15.09 a	9.02 a	9.12 a
S2	Banana trunk	15.21 a	8.93 a	8.93 a
S3	Weed + banana trunk	15.12 a	8.99 a	8.75 a
J1S1	JLF with molasses + weed	15.14 a	8.98 a	9.11 a
J1S2	JLF with molasses + banana trunk	15.30 a	8.99 a	9.01 a
J1S3	JLF with molasses + weed + banana trunk	15.19 a	8.97 a	8.44 a
J2S1	JLF without molasses + weed	15.04 a	9.05 a	9.13 a
J2S2	JLF without molasses + banana trunk	15.12 a	8.87 a	8.84 a
J2S3	JLF without molasses + weed + banana trunk	15.05 a	9.00 a	9.06 a
F-test	Main plot	ns	ns	ns
F-test	Subplot	ns	ns	ns
F-test	A × B	ns	ns	ns
CV%	Main plot (JLF)	1.03	0.42	6.79
CV%	Subplot (materials)	2.21	1.18	2.91

Note: Means with the same letter are not significantly different from each other. ns = not significant.

3.3.2 Fresh Pod Yield and Computed Yield

Table 3 presents fresh pods per plant, fresh pod weight per plant, and computed yield per hectare. No significant differences were observed for any of these parameters.

For fresh pods per plant, molasses-based JLF (J1, 69.33) produced numerically higher values than salt-based JLF (J2, 65.67). Among material sources, banana trunk alone (S2, 67.83) and weed alone (S1, 67.34) and weed+banana trunk (S3, 67.34) produced comparable numerical values. The highest numerical number of fresh pods was recorded in J1S3 (71.00), followed by J1S1 (68.67) and J1S2 (68.33).

For fresh pod weight per plant, molasses-based JLF (J1, 610.89 g) produced numerically higher values than salt-based JLF (J2, 591.67 g). Weed alone (S1, 614.67 g) produced the highest numerical weight among material sources. Among treatment combinations, J1S1 (628.67 g) produced the highest numerical fresh pod weight.

For computed yield per hectare, molasses-based JLF (J1, 12,833.61 kg/ha) produced numerically higher yield than salt-based JLF (J2, 12,442.08 kg/ha). Among material sources, banana trunk alone (S2, 12,941.67 kg/ha) produced the highest numerical yield, followed by weed+banana trunk (S3, 12,756.25 kg/ha) and weed alone (S1, 12,215.63 kg/ha). Among treatment combinations, J1S2 (molasses-based JLF + banana trunk) produced the highest numerical computed yield (13,508.33 kg/ha), followed by J2S3 (12,978.33 kg/ha) and J1S3 (12,534.17 kg/ha).

Although the computed yield was not significantly affected by the treatments, the highest numerical yield in J1S2 (molasses-based JLF + banana trunk) is agronomically noteworthy. Islam et al. [22] reported that enriched banana pseudostem sap improved nutrient uptake, yield, and quality of sweet corn, while Abro et al. [23] found that banana pseudostem sap improved vegetative growth and yield attributes of onion. Mahalakshmi and Naveena [21] also noted that fermented banana pseudostem waste contains potassium and cellulolytic bacteria that can help improve plant growth.

TABLE 3
FRESH POD NUMBER, FRESH POD WEIGHT, AND COMPUTED YIELD OF SNAP BEANS APPLIED WITH SALT-BASED AND MOLASSES-BASED JLF USING DIFFERENT PLANT MATERIAL SOURCES

Code	Description	Fresh pods per plant	Fresh pod weight (g/plant)	Computed yield (kg/ha)
J1	JLF with molasses	69.33 a	610.89 a	12,833.61 a
J2	JLF without molasses	65.67 a	591.67 a	12,442.08 a
S1	Weed	67.34 a	614.67 a	12,215.63 a
S2	Banana trunk	67.83 a	605.34 a	12,941.67 a
S3	Weed + banana trunk	67.34 a	583.83 a	12,756.25 a
J1S1	JLF with molasses + weed	68.67 a	628.67 a	12,458.33 a
J1S2	JLF with molasses + banana trunk	68.33 a	614.67 a	13,508.33 a
J1S3	JLF with molasses + weed + banana trunk	71.00 a	589.33 a	12,534.17 a
J2S1	JLF without molasses + weed	66.00 a	600.67 a	11,972.92 a
J2S2	JLF without molasses + banana trunk	67.33 a	596.00 a	12,375.00 a
J2S3	JLF without molasses + weed + banana trunk	63.67 a	578.33 a	12,978.33 a
F-test	Main plot	ns	ns	ns
F-test	Subplot	ns	ns	ns
F-test	A × B	ns	ns	ns
CV%	Main plot (JLF)	13.35	19.16	6.58
CV%	Subplot (materials)	7.61	8.91	12.31

Note: Means with the same letter are not significantly different from each other. ns = not significant.

3.3.3 Cost and Return Analysis

The cost and return analysis in Table 4 shows that J1S2 (molasses-based JLF + banana trunk) produced the highest gross income (₱810,499.80), the highest net income (₱629,750.40), and the highest ROI (348.41%). The second-highest ROI was obtained from J2S3 at 334.92%, followed by J1S3 at 316.35%, J2S2 at 314.43%, J1S1 at 314.11%, and J2S1 at 301.50%. Although J1S2 also had the highest total expense (₱180,749.00), its higher numerical yield generated the greatest financial return.

These results indicate that profitability was influenced more by marketable yield than by small differences in production cost. The superior economic performance of J1S2 supports the practical value of combining molasses-based JLF with banana trunk material, even though the yield differences were not statistically significant.

TABLE 4
COST AND RETURN ANALYSIS FOR SNAP BEANS APPLIED WITH MOLASSES-BASED AND SALT-BASED JLF PREPARED FROM DIFFERENT PLANT MATERIAL SOURCES

Treatment	Total expenses (₱)	Gross income (₱)	Net income (₱)	ROI (%)
J1S1	1,80,509.00	7,47,499.80	5,66,990.40	314.11
J1S2	1,80,749.00	8,10,499.80	6,29,750.40	348.41
J1S3	1,80,629.00	7,52,050.20	5,71,420.80	316.35
J2S1	1,78,924.00	7,18,375.20	5,39,451.40	301.5
J2S2	1,79,164.00	7,42,500.00	5,63,336.20	314.43
J2S3	1,79,044.00	7,78,699.80	5,99,656.00	334.92

Note: ROI = (Net income ÷ Total expenses) × 100. Currency in Philippine Pesos (₱).

IV. CONCLUSION

This study evaluated the effects of molasses-based and salt-based JADAM liquid fertilizers using different plant material sources on the growth, yield, and profitability of snap beans. The results showed that while most growth and yield parameters (plant height, lateral branches, pod length, pod diameter, pod weight, fresh pod number, fresh pod weight, and computed yield) were not significantly affected by the treatments, molasses-based JLF showed numerical advantages over the salt-based formulation in several traits.

A significant interaction ($P < 0.01$) was observed for days to flowering, with the earliest flowering recorded in molasses-based JLF combined with weed (J1S1) and molasses-based JLF combined with weed+banana trunk (J1S3). Among all treatment combinations, molasses-based JLF with banana trunk (J1S2) achieved the highest numerical computed yield and profitability, with a gross income of ₱810,499.80, a net income of ₱629,750.40, and a 348.41% ROI. Based on these observed trends, J1S2 may be considered the most practical and profitable treatment for snap bean production under the conditions of this experiment.

It is important to note that the absence of statistically significant differences for most parameters does not indicate treatment failure; rather, it suggests that the tested JLF formulations and plant material sources were statistically comparable in their agronomic effects. The numerical trends observed, particularly the superior profitability of J1S2, provide useful guidance for farmers seeking cost-effective organic fertilizer options. Future research should include a synthetic fertilizer control to establish the relative performance of JLF treatments compared to conventional practices, and should consider multi-season trials to account for seasonal variability.

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CONFLICT OF INTEREST

The author declares that there are no conflicts of interest about the publication of this study. No financial, personal and professional relationships influenced the conduct and results of the study. All of data and findings from this research were attained and analyzed solely for academic purposes.

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