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Research on the effects of planting season, density and spacing on the growth, development and yield components of honeysuckle (*Lonicera japonica* Thunb.)

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ABSTRACT

Honeysuckle (*Lonicera japonica* Thunb.) has traditionally been used in medicine to treat mastitis, boils, itching, and allergic conditions. This study was conducted in Gia Lai to determine the appropriate planting season, density, and spacing to optimize the growth, development, yield, and quality of honeysuckle. May was identified as the optimal planting season, suitable for achieving high yield, vigorous growth, and good medicinal quality. The most suitable planting spacing for honeysuckle is 0.8 m × 0.8 m, corresponding to a density of 15,600 plants per hectare. The average yield of dried honeysuckle flowers ranges from 0.7 to 0.8 tons per hectare, while the yield of honeysuckle stems reaches 7.5 tons or more. The active compound content meets the standards specified in the Vietnamese Pharmacopoeia V (2017).

Keywords: Honeysuckle, *Lonicera japonica*, planting season, density

1. INTRODUCTION

Honeysuckle (*Lonicera japonica* Thunb.) is a widely used traditional Chinese medicine (Shang X., *et al.*, 2011) [1], extract is rich in active substances (Tang X., *et al.*, 2021) [2], a highly valuable medicinal plant traditionally used to treat boils, urticaria, pruritus, measles,

dysentery, and cough caused by lung heat, Honeysuckle (*Lonicera japonica* Thunb.) has long been used as an antipyretic, anti-inflammatory and anti-infectious agent in East Asia (Hsu H.F., *et al.*, 2016) [3], as well as for improving lipid metabolism in hyperlipidemia (flower buds, stems, and leaves) (Li Y., *et al.*, 2015) [4]. The floral buds also exhibit antibacterial properties. In recent years, the domestic and export demand for honeysuckle has increased significantly, requiring a stable raw material supply with high yield and quality that meets pharmacopoeial standards. To achieve this, research on appropriate cultivation techniques is essential.

Planting season, density, and spacing are considered key agronomic factors that strongly affect the growth, development and yield of honeysuckle (Zheng S., *et al.*, 2022) [5]. A suitable planting season allows plants to take advantage of favorable climatic conditions sunlight, rainfall, temperature (Phip, N. T., *et al.*, 2018) [6] while optimal density and spacing reduce nutrient competition, improve aeration, limit pest incidence, and enhance land-use efficiency. According to the literature *Medicinal Plants and Animals Used in Vietnam*, honeysuckle is commonly propagated by stem cuttings in September - October or February - March (Wang, L., *et al.*, 2009) [7], with autumn and spring being highly favorable seasons for growth.

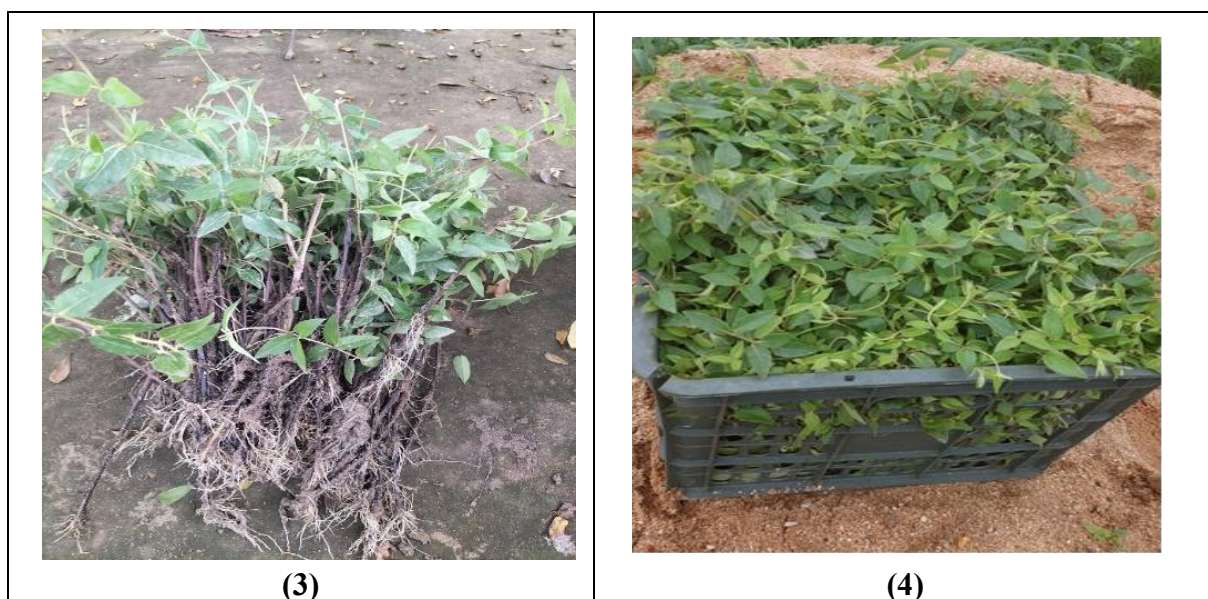
However, in the Central Highlands characterized by two distinct seasons (rainy and dry) these recommendations may not fully align with local ecological conditions. Honeysuckle seedlings aged 40 days in the nursery, with an average height of 16,43 cm, 4,5 leaves, and stem diameter of 1,03 mm, have been identified as suitable for vegetative propagation (Lien, T., *et al.*, 2025) [8]. Based on practical requirements, this study titled “Effects of Planting Season and Planting Density Spacing on the Growth, Development and Yield Components of Honeysuckle (*Lonicera japonica* Thunb.)” was conducted to determine the optimal planting season and density. The findings will contribute to improving cultivation techniques, enhancing yield, production efficiency and medicinal quality, ultimately meeting increasing market demands.

2. MATERIALS AND METHODS

2. 1. Plant materials, study period, and location

Plant material: Honeysuckle (*Lonicera japonica* Thunb.) stem cuttings collected from mother plants maintained at the cultivation model of the Military Institute of Traditional Medicine.





Figures 1-4. The honeysuckle (*Lonicera japonica* Thunb.) plant for research purposes

Research period: June 2023 - November 2025.

Research location: Gia Lai Province, Vietnam.

2. 2. Research contents

Evaluation of the effects of planting season on honeysuckle growth and yield components.
Evaluation of the effects of planting density and spacing on honeysuckle growth and yield components.

2. 3. Research methods

Effect of planting season. Three planting seasons were tested:

Treatment 1: May

Treatment 2: August (control)

Treatment 3: September

A single-factor experiment arranged in a randomized complete block design (RCBD) with three replications. Plot size: 10 m².

Planting density: 12,500 plants/ha.

Fertilization: 15 tons/ha of well-composted manure + 1 tons/ha NPK.

Effect of planting density and spacing

Three spacing treatments were evaluated:

Treatment 1: 0.8 m × 0.8 m → 15,600 plants/ha

Treatment 2: 1 m × 0.8 m → 12,500 plants/ha (control)

Treatment 3: 1 m × 1.0 m → 10,000 plants/ha

The single-factor experiment was arranged in a randomized complete block design (RCBD) with three replications. Each experimental plot had an area of 10 m². The fertilizer

application included 15 tons/ha of well-composted manure and 1 ton/ha of NPK fertilizer. The planting time was in August.

2. 4. Data collection

*** Growth indicators**

Survival rate (%): (Total number of plants planted / Total number of surviving plants) × 100. Plant height (cm): Measured from the stem base to the tip of the apical leaf using a measuring ruler (straight or flexible). Stem diameter (cm): Measured at 1 cm above the stem base using a micrometer caliper.

*** Incidence of major pests and diseases in the field**

Pest composition survey method

The survey and detection of insect pests were conducted according to the “Basic Survey Methods for Agricultural Pests and Their Natural Enemies”. Pest occurrence was assessed through direct field surveys at different plant growth stages in each experimental treatment (Lin, L. M., *et al.*, 2008) [9]. Observations were made from a distance and then at close range, followed by direct examination of the plants or plant organs.

Monitoring indicator: The occurrence degree (OD) was calculated following the formula described in the Method for Pest and Disease Detection Surveys

$$OD = \frac{\text{Number of detection points}}{\text{Total number of survey points}} \times 100$$

Table 1. Method for assessing the level of prevalence.

Symbol	Prevalence level	Frequency
+	Very low prevalence	< 10%
++	Low prevalence	10–25%
+++	Common	25–50%
++++	Very common	> 50%

Insect identification and classification method

All collected specimens were preserved and identified according to the “Basic Survey Methods for Agricultural Pests and Their Natural Enemies” and based on the identification keys (Borror D.J., *et al.*, 1989) [10].

Disease detection survey method

Disease detection surveys were conducted following the “Basic Survey Methods for Agricultural Pests and Their Natural Enemies”. Diseases were investigated through direct field surveys at different plant growth stages in each treatment or planting site. Observations were

made from a distance and then at close range, followed by direct examination of the plants or affected plant parts.

Monitoring indicator: The occurrence degree (OD) was calculated using the formula described (*Method for Pest and Disease Detection Surveys*).

$$OD = \frac{\text{Number of detection points}}{\text{Total number of survey points}} \times 100$$

Method for assessing the level of prevalence as Table1

2. 5. Data analysis

Data processed using Excel 2010 and IRRISTAT 5.0 [5].

3. RESULTS AND DISCUSSION

3. 1. Effects of planting season

3. 1. 1. Effects of planting season on honeysuckle growth and development

To evaluate the effects of planting season on the growth, yield, and active compound content of honeysuckle, the experiment was conducted using three different planting times: early rainy season (May), mid - rainy season (August), and late rainy season (September). The results on survival rate, growth, and development of honeysuckle under the different planting seasons are presented in Table 2.

The survival rate of honeysuckle decreased as the planting season was delayed. Treatment 1 (planted in May) recorded the highest survival rate (96,5%), followed by Treatment 2 (91,4%), and the lowest in Treatment 3 (85,9%). This difference reflects the favorable climatic conditions at the beginning of the rainy season (May), which provide an optimal environment for root establishment, post-transplant recovery, and stable early growth. The relatively stable temperature and humidity during this period help enhance plant survival after planting.

In terms of growth, plants in Treatment 1 exhibited markedly superior main stem length (210,5 cm) compared with Treatment 2 (154,8 cm) and Treatment 3 (147,8 cm). Statistical analysis showed that the difference between Treatment 1 and the remaining treatments was significant at the 95% confidence level ($LSD_{0.05} = 10,88$ cm), confirming the growth advantage of planting in May. This may be attributed to early planting allowing plants to take full advantage of favorable ecological conditions (warm temperatures and consistent rainfall), thereby promoting rapid height development (Liu, Z. X., *et al.*, 2015) [11].

The number of first-order branches an indicator of canopy expansion was also highest in Treatment 1 (15,2 branches/plant), significantly greater than in Treatment 3 (13,4 branches/plant). This indicates that early planting not only enhances axial growth but also stimulates branching, contributing to a well-developed canopy (Sun, C., *et al.*, 2010) [12], which is essential for flowering and biomass accumulation later in the growth cycle.

Regarding flowering time, Treatment 1 exhibited substantially later flowering and peak flowering compared with Treatment 2 and Treatment 3. Specifically, the number of days from planting to flowering in Treatment 1 was 296 days, whereas Treatment 2 and Treatment 3 required only 135 and 124 days, respectively. This difference reflects the plant's growth

allocation strategy under different planting seasons: plants established in May prioritize vegetative growth before transitioning to reproduction, thereby prolonging the vegetative phase (Zheng, S., *et al.*, 2025) [13].

Table 2. Effects of planting season on the survival rate, growth, and development of honeysuckle.

Treatment	Survival rate (%)	Main stem length (cm)	Number of first-order branches	Days to flowering	Days to peak flowering	Days to flower senescence
Treatment 1	96.5	210.5	15.2	296	328	363
Treatment 2 (Control)	91.4	154.8	14.5	135	179	214
Treatment 3	85.9	147.8	13.4	124	181	216
LSD _{0.05}	—	10.88	1.33	10.92	7.35	7.35
CV (%)	—	3.2	4.6	3.0	1.6	1.4

Note: Treatment 1: Planted in May; Treatment 2: Planted in August (Control); Treatment 3: Planted in September.

The time to peak flowering was also much longer in Treatment 1 (328 days) than in Treatment 2 (179 days) and Treatment 3 (181 days). Although the difference between Treatment 2 and Treatment 3 was not statistically significant, the contrast between Treatment 1 and the other two treatments was clear. Additionally, the duration of flower senescence was longest in Treatment 1 (363 days), contributing to an increased usable floral yield for medicinal harvesting (Yuan, Y., *et al.*, 2014) [14].

3. 1. 2. Effects of planting season on the incidence of pests and diseases in honeysuckle

The results on the effects of different planting seasons on pest and disease incidence in honeysuckle are presented in Table 3.

Table 3. Effects of planting season on pest and disease incidence in honeysuckle.

No.	Pest/Disease	Time of occurrence	Severity/Incidence		
			Treatment 1	Treatment 2	Treatment 3
1	Leaf-feeding insects (armyworms, leaf rollers)	January - February; September - October	+	+	+

2	Leaf spot disease (<i>Corynespora cassiicola</i>)	March - June; November - December	5,6	6,4	6,9
3	Stem and root rot	July - August	9,2	9,5	8,8
4	Aphids	January - September	+	+	+

Note: Treatment 1: Planted in May; Treatment 2: Planted in August (Control); Treatment 3: Planted in September

The monitoring results showed that the major pests and diseases affecting honeysuckle included leaf-feeding insects (armyworms and leaf rollers), leaf spot disease (*Corynespora cassiicola*), stem and root rot and aphids.

Leaf-feeding insects were observed in all three treatments (Treatment 1, Treatment 2, Treatment 3) during January - February and September - October. These pests were common and occurred throughout the growing cycle. Their incidence did not differ significantly among planting seasons, suggesting that weather conditions particularly temperature and humidity and canopy density may play a more important role in pest development than the planting time.

Leaf spot disease (caused by *Corynespora cassiicola*) occurred mainly during March - June and November - December. The severity of infection tended to increase with later planting dates, with the lowest incidence in Treatment 1 (5,6%) and the highest in Treatment 3 (6,9%). This indicates that early planting (May) provides better growth conditions, resulting in healthier foliage and enhanced disease resistance (Kakuda, R., *et al.*, 2000) [15]. In contrast, plants established later (Treatment 3) may not have developed sufficiently before entering the cool and humid period, making them more susceptible to fungal infection.

Stem and root rot occurred primarily during the heavy rainfall period (July - August), with relatively high infection levels (~9%) across all treatments. Differences among treatments were minimal, suggesting that this disease is influenced more by soil moisture and waterlogging conditions than by planting season.

Aphids were recorded from January to September in all treatments. This is a common pest that tends to proliferate under dry, hot conditions or on weak, poorly maintained plants. Similar to leaf-feeding insects, aphid incidence did not depend on planting season.

In summary, planting honeysuckle in May (Treatment 1) helps reduce the severity of foliar diseases, particularly leaf spot caused by fungi, due to more favorable growth conditions and improved plant resilience (Wu Q., *et al.*, 2024) [16]. Meanwhile, insect pests such as leaf feeding insects and aphids occurred widely and were not influenced by planting season; therefore, regular pest management measures are required throughout the cultivation period.

3. 1. 3. Effects of planting season on yield

In the first year, the highest fresh stem leaf yield was obtained in Treatment 1 (planted in May), with an average of 23,5 tons/ha, followed by Treatment 2 (August) with 19,5 tons/ha, and the lowest in Treatment 3 (September) with 16,7 tons/ha. Statistical analysis showed that the differences in fresh biomass yield among treatments were significant at the 95% confidence level ($LSD_{0.05} = 2,81$ tons/ha) (Tae J., *et al.*, 2003) [17]. Similarly, dry stem leaf yield also showed a decreasing trend with later planting dates, with Treatment 1 achieving the highest

value (4,43 tons/ha), followed by Treatment 2 (3,64 tons/ha), and the lowest in Treatment 3 (3,11 tons/ha). The differences among treatments exceeded the LSD value (0,524 tons/ha), confirming statistically significant variation (Xiong J., *et al.*, 2013) [18]. This indicates that early planting not only enhances fresh biomass accumulation but also improves dry matter formation.

Table 4. Effects of planting season on honeysuckle yield.

Treatment	Year 1		Year 2			
	Fresh stem leaf yield (tons/ha)	Dry stem leaf yield (tons/ha)	Fresh stem leaf yield (tons/ha)	Dry stem leaf yield (tons/ha)	Fresh flower yield (tons/ha)	Dry flower yield (tons/ha)
Treatment 1	23,5	4,43	29,1	5,52	3,22	0,56
Treatment 2 (Control)	19,5	3,64	23,8	4,51	2,66	0,46
Treatment 3	16,7	3,11	20,1	3,83	2,50	0,43
LSD _{0,05}	2,81	0,524	2,74	0,592	0,351	0,049
CV (%)	7,1	7,1	5,6	6,4	6,3	5,1

Note: Treatment 1: Planted in May; Treatment 2: Planted in August (Control); Treatment 3: Planted in September

In the second year, the same trend was observed, with Treatment 1 continuing to produce the highest fresh and dry biomass yields, reaching 29,1 tons/ha and 5,52 tons/ha, respectively, compared with Treatment 2 (23,8 tons/ha and 4,51 tons/ha) and Treatment 3 (20,1 tons/ha and 3,83 tons/ha). The differences between Treatment 1 and the other treatments were statistically significant at the 95% confidence level, demonstrating the strong influence of planting season on stem leaf biomass production.

Regarding flower yield, both fresh and dry flower yields were highest in Treatment 1, followed by Treatment 2 and Treatment 3. Specifically, fresh flower yield in Treatment 1 reached 3,22 tons/ha, significantly higher than Treatment 2 (2,66 tons/ha) and Treatment 3 (2,50 tons/ha). Dry flower yields were 0,56, 0,46, and 0,43 tons/ha, respectively. All differences were statistically significant (LSD_{0,05} = 0,351 tons/ha for fresh flowers and 0,049 tons/ha for dry flowers). Although Treatment 3 had an earlier flowering time (as shown in the previous table), floral yield remained lower because plants had not accumulated sufficient vegetative biomass prior to floral initiation.

Overall, the results clearly demonstrate that planting season strongly affects both stem leaf and flower yields of honeysuckle (Li, P., *et al.*, 2016) [19]. Among the treatments, 1 (planting in May) produced the highest and statistically superior yields for all indicators in both

years. Treatment 2 (August) yielded moderate results, whereas Treatment 3 (September) consistently produced the lowest values.

Based on the findings, planting season has a marked influence on biomass and floral productivity in honeysuckle. Planting in May (Treatment 1) provides the most favorable conditions for maximizing yield in both stem leaf and flower production, making it the optimal planting time, especially for producing high quality dried flowers and medicinal raw materials. Selecting the appropriate planting season is therefore a key factor in improving cultivation efficiency and economic value.

In conclusion, the study evaluating three planting seasons (May, August, and September) demonstrated significant effects on survival rate, growth, flowering ability, yield, and active compound content in both stems leaves and flowers of honeysuckle. May is identified as the optimal planting time when the production goal is high yield, vigorous growth, and superior medicinal quality. Later planting seasons (August and September) can shorten the flowering period but are not suitable when overall production efficiency and quality are prioritized.

3. 2. Effects of planting density and spacing on the growth, yield and active compound content of honeysuckle

3. 2. 1. Effects of planting density and spacing on the growth and development of honeysuckle

Table 5. Effects of planting density and spacing on the survival rate, growth and development of honeysuckle.

Treatment	Survival rate (%)	Main stem length (cm)	Number of primary branches	Days from planting to flowering	Days from planting to full bloom	Flower senescence period (days)
Treatment 1	90.5	165.3	13.2	135	181	216
Treatment 2 (Control)	91.2	156.7	14.6	135	180	215
Treatment 3	90.8	155.8	15.4	132	175	210
LSD _{0,05}	—	12.01	1.42	7.01	7.65	6.92
CV (%)	—	3.8	4.9	2.6	2.1	1.6

Note:

Treatment 1: Spacing 0.8 m × 0.8 m, corresponding to a density of 15,600 plants/ha.

Treatment 2: Spacing 1.0 m × 0.8 m, corresponding to a density of 12,500 plants/ha.

Treatment 3: Spacing 1.0 m × 1.0 m, corresponding to a density of 10,000 plants/ha.

The survival rate of plants in all three treatments (Treatment 1, Treatment 2, Treatment 3) was high and relatively similar, ranging from 90,5% to 91,2%. The differences among treatments were negligible, indicating that planting densities between 10.000 and 15.600

plants/ha did not significantly affect the survival rate of honeysuckle. Treatment 1 (the highest density, 15.600 plants/ha) produced the greatest main stem length (165,3 cm), whereas Treatment 3 (the lowest density, 10.000 plants/ha) had the shortest main stem length (155,8 cm). However, the differences in main stem length among treatments were not statistically significant at the 5% level, suggesting that planting density within this range did not markedly influence stem elongation.

The number of primary branches increased as planting density decreased: Treatment 1 produced 13,2 branches, while Treatment 3 produced 15,4 branches. The difference between Treatment 1 and Treatment 3 was statistically significant at the 95% confidence level.

Planting density had little effect on flowering time, with all treatments showing similar values, ranging from 132 to 135 days.

3. 2. 2. Effects of planting density and spacing on pest and disease incidence in honeysuckle

Table 6. Effects of planting density and spacing on pest and disease incidence in honeysuckle.

No.	Pest/Disease	Time of occurrence	Severity/Incidence		
			Treatment 1	Treatment 2	Treatment 3
1	Leaf-feeding insects (armyworms, leaf rollers)	January - February; September - October	+	+	+
2	Leaf spot disease (<i>Corynespora cassiicola</i>)	March - June; November - December	6,2	5,8	5,1
3	Stem and root rot	July - August	9,8	9,1	8,7
4	Aphids	January - September	+	+	+

Note:

Treatment 1: Spacing 0.8 m × 0.8 m, corresponding to a density of 15,600 plants/ha.

Treatment 2: Spacing 1 m × 0.8 m, corresponding to a density of 12,500 plants/ha.

Treatment 3: Spacing 1 m × 1 m, corresponding to a density of 10,000 plants/ha.

Higher planting density (Treatment 1) increased the severity of certain major diseases, such as leaf spot and stem/root rot. Leaf feeding insects and aphids occurred across all densities and were not markedly affected by planting density (Zheng, J., 2024) [20]. To reduce disease incidence, lower planting density (Treatment 3) is recommended, as it improves canopy ventilation and decreases disease pressure.

At the same time, pest and disease management measures should be strengthened, especially during periods of high infestation.

3. 2. 3. Effects of planting density and spacing on honeysuckle yield

Table 7. Effects of planting density and spacing on the yield of honeysuckle.

Treatment	Year 1		Year 2			
	Fresh stem leaf yield (tons/ha)	Dry stem leaf yield (tons/ha)	Fresh stem leaf yield (tons/ha)	Dry stem leaf yield (tons/ha)	Fresh flower yield (tons/ha)	Dry flower yield (tons/ha)
Treatment 1	24,3	4,55	29,8	5,67	2,81	0,5
Treatment 2 (Control)	19,8	3,66	24,2	4,55	2,73	0,48
Treatment 3	17,1	3,18	20,7	3,88	2,62	0,46
LSD _{0,05}	2,62	0,468	2,70	0,518	0,274	0,054
CV (%)	6,4	6,2	5,4	5,5	5,0	5,7

Note:

Treatment 1: Spacing 0.8 m × 0.8 m, corresponding to a density of 15,600 plants/ha.

Treatment 2: Spacing 1 m × 0.8 m, corresponding to a density of 12,500 plants/ha.

Treatment 3: Spacing 1 m × 1 m, corresponding to a density of 10,000 plants/ha.

In the first year, fresh stem leaf yield per hectare was highest in Treatment 1 (the highest density, 15.600 plants/ha), reaching 24,3 tons/ha. Treatment 2 produced 19,8 tons/ha, approximately 4,5 tons/ha lower than Treatment 1. Treatment 3 (the lowest density, 10.000 plants/ha) recorded the lowest yield at 17,1 tons/ha. The difference in fresh biomass yield between Treatment 1 and Treatment 3 was statistically significant at the 95% confidence level. Similar to fresh biomass, dry stem leaf yield also declined as planting density decreased. Specifically, the average dry biomass yield was 4,55 tons/ha in Treatment 1, 3,66 tons/ha in Treatment 2, and 3,18 tons/ha in Treatment 3. The difference between Treatment 1 and Treatment 3 was statistically significant at the 95% confidence level.

In the second year, Treatment 1 continued to produce the highest biomass yields, with 29,8 tons/ha (fresh) and 5,67 tons/ha (dry). Treatment 2 and Treatment 3 yielded lower values, with Treatment 3 reaching only 20,7 tons/ha (fresh) and 3,88 tons/ha (dry). Statistical analysis showed that the differences between Treatment 1 and the other treatments were significant at the 95% confidence level, demonstrating the positive role of higher planting density in enhancing biomass accumulation (Yang, J., *et al.* 2007) [21]. Fresh flower yield also showed a slight decreasing trend with reduced planting density with Treatment 1, Treatment 2, and Treatment 3 producing 2,81, 2,73, and 2,62 tons/ha, respectively. However, these differences were not statistically significant at the 95% confidence level.

The results indicate that a planting density of 15.600 plants/ha (0,8 m × 0,8 m - Treatment 1) is the optimal treatment, producing the highest biomass and flower yields in both years.

Increasing planting density improves land use efficiency, canopy coverage, and vegetative growth. Therefore, a spacing of 0,8 m $\times$ 0,8 m can be recommended to enhance honeysuckle productivity under conditions similar to those of the experiment.

From these results, production strategies can be outlined as follows:

If the priority is medicinal quality particularly for extracting active compounds or producing high activity products a lower planting density (Treatment 3) is preferred. Conversely, if the objective is to maximize biomass yield for raw material processing or large-scale commercial production, a higher density (Treatment 1) is appropriate, provided that suitable technical measures are applied to minimize potential negative effects on quality.

4. CONCLUSION

Planting season has a marked influence on survival rate, growth, flowering ability, yield, and active compound content of honeysuckle. May is identified as the optimal planting time, suitable for achieving high yield, vigorous growth, and good medicinal quality.

Regarding planting density, if the priority is medicinal quality particularly for active compound extraction a spacing of 1 m $\times$ 1 m (equivalent to 10.000 plants/ha) is recommended. Conversely, if the objective is to increase stem leaf biomass for raw material processing or large scale production, the higher density in Treatment 1 (0,8 m $\times$ 0,8 m, 15.600 plants/ha) is appropriate, provided that suitable technical measures are applied to maintain quality.

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