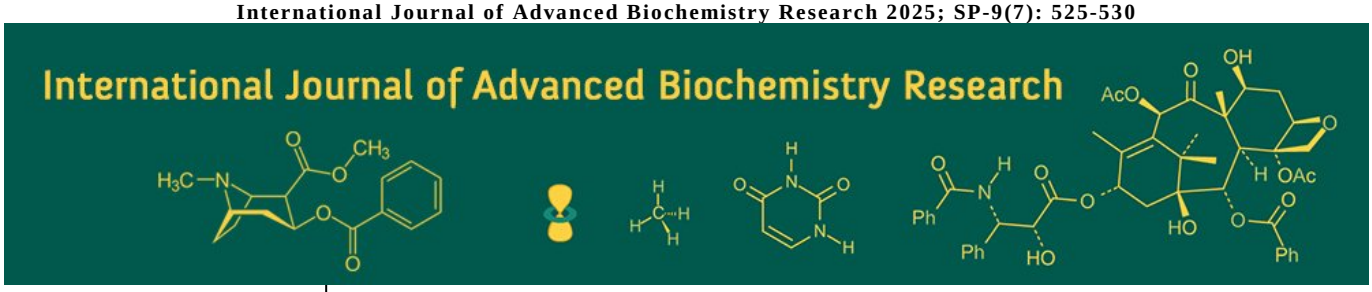

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Impact of cow urine and biofertilizers on rooting of mulberry cuttings under shed net condition

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Abstract
The study entitled "Impact of cow urine and biofertilizers on rooting of mulberry cuttings under shed net condition" was carried out during 2024-25 at the Horticulture Nursery, Department of Fruit Science, College of Agriculture, Indira Gandhi Krishi Vishwavidyalaya, Raipur (Chhattisgarh). The experiment followed a Completely Randomized Design (CRD), comprising thirteen treatments with three replications each. Thirteen treatments were formulated as follows: T_0 - control, T_1 - cow urine @5 ml/kg of rooting media, T_2 - cow urine @10 ml/kg of rooting media, T_3 - PSB @ 5 ml/kg of rooting media, T_4 - PSB @ 10 ml/kg of rooting media, T_5 - Azotobacter @ 5 ml/kg of rooting media, T_6 - Azotobacter @ 10 ml/kg of rooting media, T_7 - cow urine @ 2.5 ml/kg + PSB @ 2.5 ml/kg of rooting media, T_8 - cow urine @ 5 ml/kg + PSB @ 5 ml/kg of rooting media, T_9 - cow urine @ 10 ml/kg + PSB @ 10 ml/kg of rooting media, T_{10} - cow urine @ 2.5 ml/kg of rooting media + Azotobacter @ 2.5 ml/kg of rooting media, T_{11} - cow urine @ 5 ml/kg + Azotobacter @ 5 ml/kg of rooting media and T_{12} - cow urine @ 10 ml/kg + Azotobacter @ 10 ml/kg of rooting media. Among all treatment combinations T_9 (cow urine @ 10 ml/kg + PSB @ 10 ml/kg) exhibited superior performance in all root growth parameters. This treatment resulted in the highest root development, with a root length of 19.66 cm, root diameter of 1.98 mm and the highest number of primary (7.67) and secondary (11.05) roots. It also produced the highest fresh (5.50 g) and dry weight (3.50 g) of roots. Based on these findings T_9 can be considered the most effective for enhancing root development in mulberry cuttings.

Keywords: Biofertilizer, cow urine, PSB, *Azotobacter*, rooting media

Introduction
Mulberry belonging to the genus *Morus* in the family Moraceae. *Morus alba* originates from South Asia. Mulberry comprises both cultivated and wild species that play a crucial role in sericulture. Cultivated species like *Morus alba*, *Morus indica*, *Morus serrata* and *Morus laevigata* are primarily grown for their leaves, essential for silkworms and thrive in diverse regions from sub-Himalayan areas to tropical climates. Wild species such as *Morus nigra*, *Morus rubra*, *Morus australis* and *Morus boninensis* are valued for their genetic diversity, adaptability and hybridization programs. Mulberry cultivation is carried out across different climatic regions, with the majority of the cultivation concentrated in the tropical zone, particularly in Karnataka, Andhra Pradesh and Tamil Nadu. In the sub-tropical zone, significant mulberry-growing areas are found in West Bengal, Himachal Pradesh and the North-Eastern states. Mulberry is primarily propagated using hardwood cuttings, which offer distinct benefits such as quick multiplication of planting material and preservation of the plants desired traits. The success of stem cutting propagation is influenced by several factors including environmental conditions, the timing of cutting collection, the age of the mother plant and treatments with plant growth regulators (PGRs) and biofertilizers (Sharma, 1994). In mulberry (*Morus* spp.) cultivation cow urine is gaining attention particularly for promoting root development and resistance to diseases in stem cuttings. Its rich nutrient profile and antimicrobial properties make it an eco-friendly alternative to chemical fertilizers. Biofertilizers significantly enhance the rooting of mulberry cuttings by facilitating nutrient availability to developing roots. Phosphate Solubilizing Bacteria (PSB) contribute to increasing phosphorus availability in the root zone. Additionally, *Azotobacter* and *Azospirillum* promote the uptake of nitrogen and other essential nutrients by making them more accessible to plants (Rathor *et al.*, 2020) [4]. The findings will contribute to the

development of organic and cost-effective strategies for mulberry cultivation, promoting sustainable agriculture, reduced chemical dependency and improved soil health.

2. Materials and method

This study investigated the impact of cow urine, PSB, *Azotobacter* and their various combinations at different concentrations on rooting of mulberry cuttings. A growing media composed of soil, sand and farm yard mannure in a 2:1:1 ratio was used for all treatments. The treatment details included: T_0 - control, T_1 - cow urine @5 ml/kg of rooting media, T_2 - cow urine @10 ml/kg of rooting media, T_3 - PSB @ 5 ml/kg of rooting media, T_4 - PSB @ 10 ml/kg of rooting media, T_5 - Azotobacter @ 5 ml/kg of rooting media, T_6 - Azotobacter @ 10 ml/kg of rooting media, T_7 - cow urine @ 2.5 ml/kg + PSB @ 2.5 ml/kg of rooting media, T_8 - cow urine @ 5 ml/kg + PSB @ 5 ml/kg of rooting media, T_9 - cow urine @ 10 ml/kg + PSB @ 10 ml/kg of rooting media, T_{10} - cow urine @ 2.5 ml/kg of rooting media + Azotobacter @ 2.5 ml/kg of rooting media, T_{11} - cow urine @ 5 ml/kg + Azotobacter @ 5 ml/kg of rooting media and T_{12} - cow urine @ 10 ml/kg + Azotobacter @ 10 ml/kg of rooting media. For each treatment ten poly bags of 6"x3" size were used. Small holes were made in each bag to ensure proper water drainage. Cuttings measuring 15-20 cm in length with 5-6 buds were prepared for planting. Observations on all rooting parameters recorded at 120 days after planting of cuttings.

3. Result and Discussion

3.1 Length of roots (cm)

The results indicated that longest roots were observed under the treatment T_9 (Cow urine @10ml/kg + PSB @10ml/kg of rooting media) measuring 19.66 cm, followed by T_{12} (Cow urine @10ml/kg + *Azotobacter* @10ml/kg of rooting media) at 17.50 cm. This phenomenon may be due to the higher levels of growth-promoting substances, available phosphorus (P_2O_5) and other nutrients provided by PSB application. Phosphorus plays a key role in root initiation by promoting cell division and energy transfer in the form of ADP and ATP, which ultimately leads to quicker and better root development and plant growth. This findings align closely with the findings reported by Nageswari *et al.* (1999) [2]. This information is detailed in Table1 and graphically represented in Fig. 3.1.

3.2 Diameter of roots (mm)

The maximum diameter of roots of mulberry cuttings was observed 1.98 mm in treatment T_9 (Cow urine @10ml/kg + PSB @10ml/kg of rooting media). This was followed by T_{12} (Cow urine @10ml/kg + *Azotobacter* @10ml/kg of rooting media) with a root diameter of 1.80 mm. It was noticed that combining PSB with cow urine contributed to enhanced diameter of mulberry roots. These results are consistent with the finding reported by Rathore *et al.* (2020) [4]. These results are presented in Table 1 and illustrated in Fig. 3.2.

3.3 Number of primary roots

The maximum number of primary roots was also observed in treatment T_9 which involved (Cow urine @10ml/kg + PSB @10ml/kg of rooting media) having the value of 7.67 followed by T_{12} (Cow urine @10ml/kg + *Azotobacter* @10ml/kg of rooting media) with 7.50 primary roots. The increase in number of primary roots in cuttings under PSB treatment may be attributed to the enhanced production of growth-promoting substances and better availability of phosphorus. These factors collectively contribute to increased root formation. Similar observations were reported by Wange and Ranawade (1997) [7]. The results are shown in Table 1 and illustrated in Figure 3.3

3.4 Number of secondry roots

The maximum number of secondry roots was observed in treatment T_9 (Cow urine @10ml/kg + PSB @10ml/kg of rooting media) with a value of 11.05, followed by T_{12} (Cow urine @10ml/kg + *Azotobacter* @10ml/kg of rooting media) with 10.61. PSB facilitates the production of auxins and improves phosphorus availability, which supports better root growth. This positive effect of PSB on root formation and development is consistent with the research conducted by Patil *et al.* (2004) [3] in pomegranate. The results were presented in Table 1 and depicted through Figure 3.4

3.5 Fresh weight of roots (g)

The maximum fresh weight of roots of mulberry cuttings was recorded under the treatment T_9 (Cow urine @10ml/kg + PSB @10ml/kg of rooting media) having the value of 5.50 g, followed by T_{12} (Cow urine @10ml/kg + *Azotobacter* @10ml/kg of rooting media) with 5.30 g. Similar results were also reported by Nageswari *et al.* (1999) [2] and Damar *et al.* (2014) [1]. The findings are presented in Table 1 and illustrated in Figure 3.5

3.6 Dry weight of roots (g)

Treatment T_9 (Cow urine @10ml/kg + PSB @10ml/kg of rooting media) found maximum dry weight of roots of mulberry cutting with 3.50 g, which was followed by T_{12} (Cow urine @10ml/kg + *Azotobacter* @10ml/kg of rooting media) with 3.42 g. This might be because PSB increase the levels of plant growth substances in the cuttings. Similar results were reported seen by Sharma and Bhutani (1998) [6] in apple and by Damar *et al.* (2014) [1] in pomegranate cuttings. The detailed results are shown in Table1 and illustrated in Figure 3.6

Table 1: Effect of cow urine and biofertilizers on different rooting parameters of mulberry cuttings under shed net condition

Notations	Treatments	Mean					
		Length (cm)	Diameter (mm)	Number of primary roots	Number of secondary roots	Fresh weight (g)	Dry weight (g)
T_0	Control	8.16^{k}	0.40^{l}	4.72^{j}	7.01^{k}	2.90^{k}	1.82^{i}
T_1	Cow urine @5ml/kg of rooting media	12.76^{gh}	0.52^{ij}	5.56^{g}	7.89^{i}	3.84^{h}	2.20^{fg}
T_2	Cow urine @10ml/kg of rooting media	14.30^{d}	1.16^{e}	6.84^{cd}	9.77^{de}	4.78^{d}	2.84^{c}
T_3	PSB @5ml/kg of rooting media	13.92^{def}	0.65^{h}	6.04^{f}	8.95^{gh}	4.18^{fg}	2.56^{e}
T_4	PSB @10ml/kg of rooting media	17.13^{bc}	1.59^{c}	7.32^{b}	10.35^{bc}	5.26^{b}	3.25^{b}
T_5	*Azotobacter* @5ml/kg of rooting media	13.45^{efg}	0.56^{i}	5.80^{fg}	8.81^{h}	4.02^{g}	2.35^{f}
T_6	*Azotobacter* @10ml/kg of rooting media	16.68^{c}	1.40^{d}	7.02^{c}	10.07^{cd}	5.01^{c}	3.14^{b}
T_7	Cow urine @2.5ml/kg+ PSB@2.5ml/kg of rooting media	11.23^{i}	0.49^{jk}	5.26^{h}	7.67^{ij}	3.28^{i}	2.05^{gh}
T_8	Cow urine @5ml/kg + PSB @5ml/kg of rooting media	14.16^{de}	0.92^{f}	6.63^{d}	9.51^{ef}	4.42^{e}	2.78^{cd}
T_9	Cow urine @10ml/kg + PSB @10ml/kg of rooting media	19.66^{a}	1.98^{a}	7.67^{a}	11.05^{a}	5.50^{a}	3.50^{a}
T_{10}	Cow urine @2.5ml/kg + *Azotobacter* @2.5ml/kg of rooting media	10.40^{j}	0.45^{k}	5.01^{i}	7.47^{i}	3.16^{j}	1.95^{hi}
T_{11}	Cow urine @5ml/kg + *Azotobacter* @5ml/kg of rooting media	13.92^{def}	0.79^{g}	6.38^{e}	9.30^{fg}	4.25^{f}	2.65^{de}
T_{12}	Cow urine @10ml/kg + *Azotobacter* @10ml/kg of rooting media	17.50^{b}	1.80^{b}	7.50_{ab}	10.61^{b}	5.30^{b}	3.42^{a}
	SE(m) ±	0.24	0.01	0.08	0.13	0.05	0.05
	C.D. at 5%	0.71	0.04	0.24	0.38	0.16	0.15

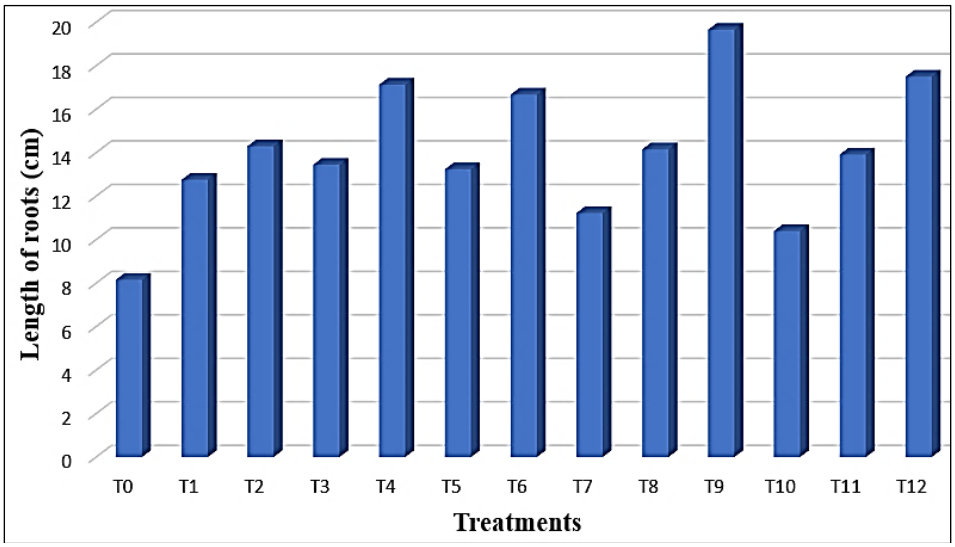

Fig 3.1: Effect of cow urine and biofertilizrs on length of roots of mulberry cuttings (cm)

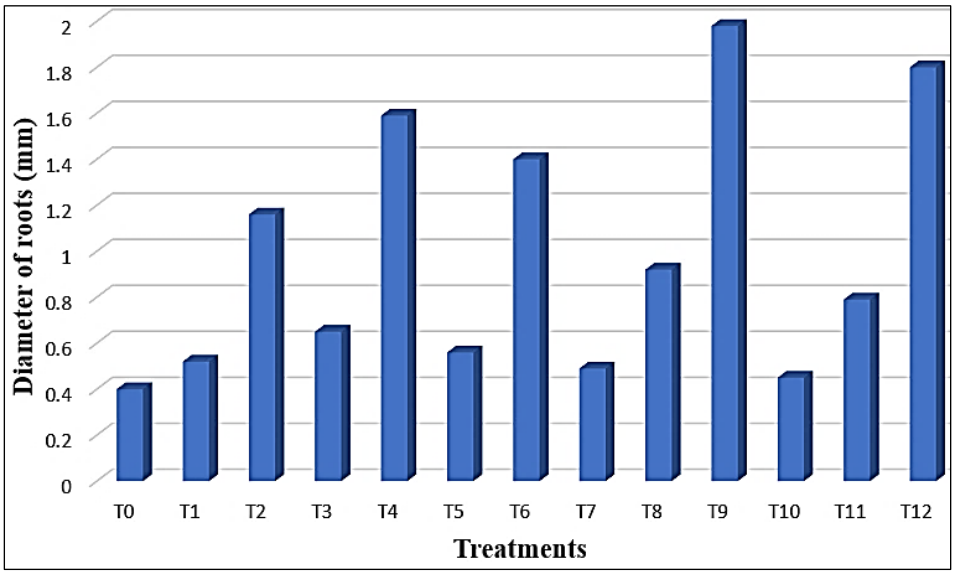

Fig 3.2: Effect of cow urine and biofertilizers on diameter of roots of mulberry cuttings (mm)

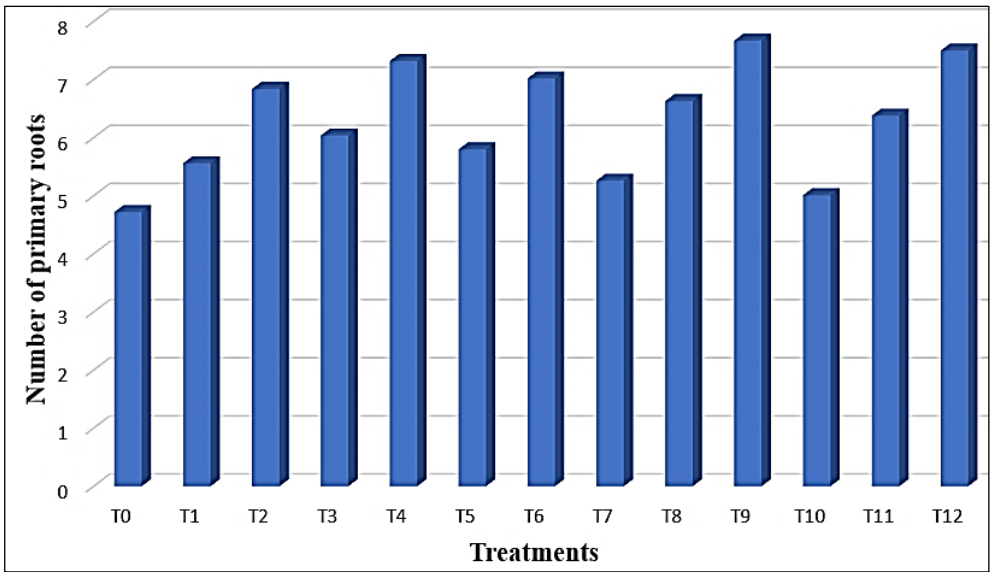

Fig 3.3: Effect of cow urine and biofertilizers on number of primary roots of mulberry cuttings

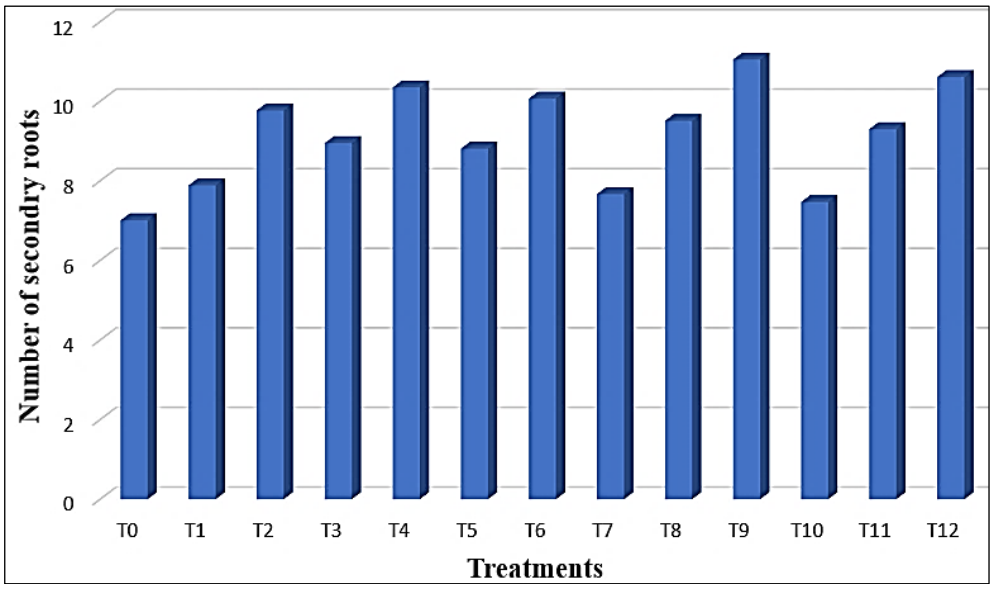

Fig 3.4: Effect of cow urine and biofertilizers on number of secondry roots of mulberry cuttings

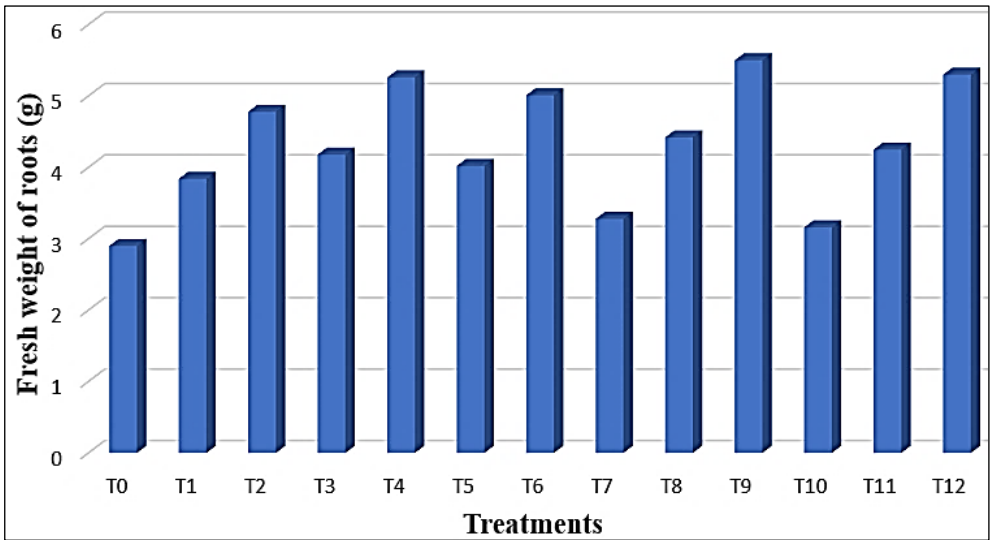

Fig 3.5: Effect of cow urine and biofertilizers on fresh weight of roots of mulberry cuttings (g)

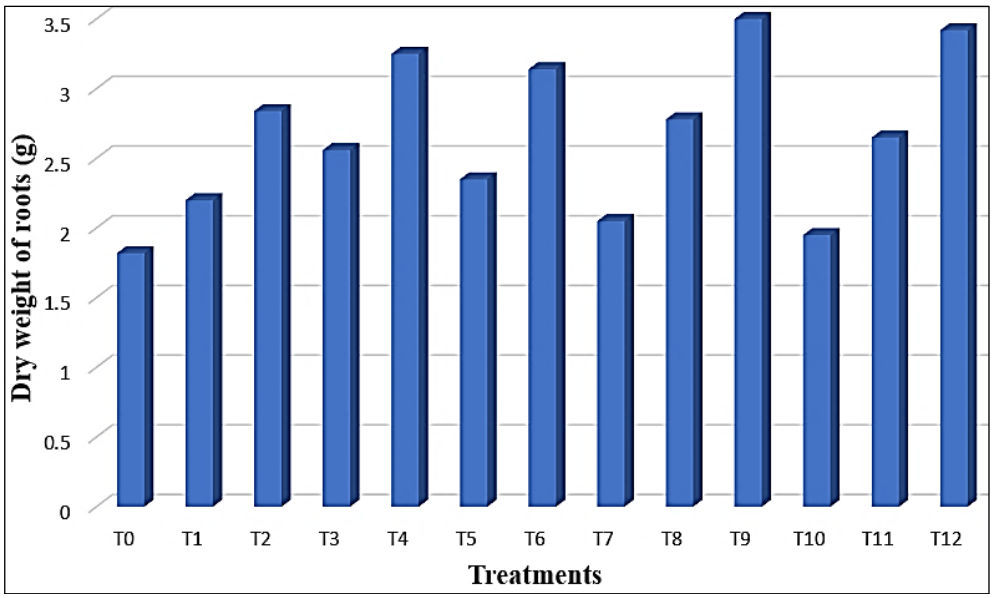

Fig 3.6: Effect of cow urine and biofertilizers on dry weight of roots of mulberry cuttings (g)

4. Conclusion

The findings of the present study clearly demonstrate that the positive impact of cow urine and biofertilizers on the rooting of mulberry cuttings under shed net conditions. Among the thirteen treatment combinations the treatment T_9 (Cow urine @10ml/kg + PSB @10ml/kg of rooting media) found the most favorable results across all roots growth parameters including length, diameter, number of primary and secondary roots, fresh and dry weight of roots of mulberry cuttings.

5. Future suggestions

1. The experiment can be expanded to include a wider range of fruit crops and their respective varieties they are propagated through cuttings in order to assess the broader applicability of the treatment.
2. In future the study can be done in different environment condition such as open field or green house to access the efficiency of cow urine, PSB and *Azotobacter* under varying condition.

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