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Short Communication

Effect of naphthalene acetic acid on rooting and shoot growth of *Lawsonia inermis*

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ABSTRACT

An experiment was carried out at the University for Development Studies, in the Northern Region of Ghana to determine the effect of naphthalene acetic acid (NAA) on the sprouting and rooting potential of stem cuttings of *Lawsonia inermis*. Results indicated that NAA had effect on the number of leaves, roots and root length per cutting. NAA did not have any significant effect on the number of sprouts per cutting, height of sprouts, leaf area index and girth of sprouts. Hardwood cuttings performed better than semi-hardwood and softwood cuttings in all the parameters assessed. It was recommended that the effect of NAA and in combination with other plant growth regulators on sprouting and rooting potential of *Lawsonia inermis* be carried out.

Keywords: *Lawsonia inermis*, naphthalene acetic acid, softwood, semi-hardwood, hardwood.

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INTRODUCTION

Lawsonia inermis L, commonly known as henna is a drought-tolerant, photo-insensitive, perennial plant belonging to the family *Lythraceace*. Henna is a native of tropical and sub-tropical regions of Africa, Southern Asia, and Northern Australia in semi-arid zones (Kumar et al., 2005; Keay et al., 1989). Henna's indigenous zone of distribution is the tropical and sub-tropical zone lies between latitude 15° and 25° N and S Africa to the Western specific rim (Singh et al., 2005). *L. inermis* is a glabrous, multibranched shrub or small tree with spine tipped branch lets. The flowers are numerous, small, white or rose colour which are highly and sweetly scented and borne profusely in large panicles (Shiva et al., 2002).

Henna has many traditional and commercial uses, the most common being a dye for hair, skin, fingernails, as a preservative for leather and cloth, and as an antifungal. The flowers have been used to create perfume since ancient times (Bosoglu et al., 1998). In countries where women are discouraged from working outside the home, they have been gainfully employed in socially acceptable, lucrative and economically viable work processing henna (Tauzin, 1998). *L. inermis* is among the oldest cosmetic plants in the world and used in the Middle-East and India for the palms of the hands, soles of the feet and fingernails (Shiva et al., 2002).

Although *L. inermis* cultivation has been on a relatively small scale in northern Ghana, it has several economic and industrial prospects due to the increasing market demand and its climatic adaptation. Seeds of *L. inermis* continue to remain the major source of planting material coupled with seasonal availability and viability of seeds are challenges for successful plantation establishment.

Research on the propagation of *L. inermis* was limited and it was considered useful to undertake a systematic study on the vegetative propagation of *L. inermis* by stem cuttings. According to Davis and Hassig (1990), the rooting of cuttings was strongly influenced by plant hormones. Understanding of the interactive effect of plant hormone and physiological ages of stem cuttings of *L. inermis* was important and poorly reported. The responses of different tree crops to plant growth regulators application vary considerably according to their genetic constitution of the plant (Nanda et al., 1968). Vegetative propagation ensures rapid multiplication of genetically pure seed material for commercial plantings (Hartmann et al., 2002). In some plant species, adventitious root formation initiates without any treatment, while others require different plant growth regulators usually auxin (Syros et al., 2004).

In the early historic days, people used to treat cuttings with manganese, boron and phosphorus but with the discovery of auxins in 1934 for their simulative effects on root initiation was a major milestone in the history of plant propagation. Various auxins such as Indole Acetic Acid (IAA), Indole Butyric Acid (IBA), Naphthalene Acetic Acid (NAA) and 2,4-Dichloropheoxy Acetic Acid (2,4-D) have been reported to promote rooting in cuttings of the most of the plant species. Napthelene Acetic Acid has been known for inducing roots in cuttings when placed in a suitable propagating medium. The study seeks to assess the effect of Naphthalene acetic acid (NAA) on the rooting and sprouting potential of different types of stem cuttings of *L. inermis*.

MATERIALS AND METHODS

The experiment was carried out in the greenhouse of the University for Development Studies, Nyankpala in the northern guinea agro-ecological zone of Ghana. The study area lies within latitude 9°25′N, longitude 0°58′W, and on altitude of 183 m above sea level of Ghana (SARI, 1997). *L. inermis* of different wood types including softwood, semi-hardwood, and hardwood stem cuttings in factorial randomized compete block design were used in this experiment.

The NAA was applied to the base of the cuttings at 0.5% w/w as a rooting agent using the dipping method. A total of six treatments combination: softwood with hormone (SW-H), softwood without hormone (SW-NH), semi-hardwood with hormone (SHW-H), semi-hardwood without hormone (SHW-NH), hardwood with hormone (HW-H), hardwood without hormone (HW-NH) was used. The experiment was carried out in poly bags filled with rooting media (one part of top soil and three parts of sea sand) and replicated three times. Cuttings approximately 8 cm in length with four buds deep in the rooting media with two buds above were used. Least significant difference (LSD) was used to compare treatment means of the experiment.

Parameters measured included number of leaves and sprouts per cutting, shoot length, number of roots and root length. Data collection started two weeks after inserting the cuttings in the rooting media and the experiment was conducted over a period of eight weeks.

RESULTS AND DISCUSSION

Generally, there were no significant differences in the number of sprouts of the experimental materials over the study period. However, there were gradual increments in the number of sprouts as the experiment progressed with 6WAP and 8WAP as the highest (Table 1). Hard-wood cuttings recorded the highest number of sprouts (8WAP), while soft-wood and semi-hardwood cuttings recorded less number of sprouts even with NAA application.

This may imply that the hardwood cuttings develop more shoots than the soft-wood and semi-hardwood cuttings probably because of its higher carbohydrate reserve (Hartmann and Kester, 1990; Dick, 2001). The hardwood stem cuttings seem to be more physiologically mature than the soft-wood and semi-hardwood cuttings as it seem to respond better to NAA (Noor Camellia et al., 2009).

Table 1. Number of sprouts per cutting in weeks after planting (WAP).

Treatment	2WAP	4WAP	6WAP	8WAP
SW-H	1.25	1.25	1.75	2.00
SW-NH	1.50	1.50	1.50	1.50
SHW-H	1.50	1.57	1.75	1.75
SHW-NH	1.25	1.50	1.75	1.75
HW-H	2.25	2.50	2.75	2.75
HW-NH	1.75	1.75	2.00	3.00
LSD	1.13	1.14	1.23	1.27

LSD = Least significant difference.

Table 2. Average root number and length eight weeks after planting (WAP).

Treatment	Root number	Root length (cm)
SW-H	5.25	12.61
SW-NH	3.75	6.31
SHW-H	6.00	11.10
SHW-NH	1.00	1.80
HW-H	9.25	10.48
HW-NH	8.25	17.30
LSD	4.60	6.48

LSD = Least significant difference.

Root number and length

Hardwood cuttings generally recorded the highest number of roots with the mean value of 9.25 and 8.25 respectively. Number of roots increase in the order of hardwood, followed by semi-hardwood with softwood cuttings as the least (Table 2). However, cuttings treated with NAA produced more roots especially in hardwood cuttings. This confirms that *L. inermis* cuttings respond to auxins that are required for adventitious roots initiation of stem cuttings (Gaspar and Holfingers, 1987). This outcome may be due to the translocation of carbohydrates from the leaves which plays important role in root development (Carvalho et al., 1995) (Table2).

Furthermore, hardwood cuttings recorded the longest roots followed by semi-hardwood cuttings with softwood cuttings with the least root length (Table 2). These increase in root length maybe due to an early initiation of roots at physiologically matured stage of hardwood cuttings and more utilization of the food materials due to early formation of roots. The ability of cuttings treated

Table 3. Determination of % moisture content (MC) and dry matter of *Lawsonia inermis* leaves.

Treatments	Fresh weight	Dry weight	% MC
SW-H	7.98	6.45	23.0
SW-NH	7.80	6.65	17.3
SHW-H	9.05	6.90	31.2
SHW-NH	8.68	6.85	26.7
HW-H	12.78	9.32	37.1
HW-NH	13.55	12.02	12.2
LSD	2.40	4.17	6.77

LSD = Least significant difference.

with auxin to root depends on the age of the plant from which the cuttings were taken (Avery and Johnson, 1947; Thiaman and Behnke, 1950) as well as hormone application except in hardwood cutting (Table 2).

Dry matter and % moisture determination

Hardwood cuttings recorded the highest fresh and dry matter weights followed by semi-hardwood and softwood cuttings respectively. More dry matter weight (0.290 g) of the roots per cutting was recorded in the hardwood cuttings not treated with NAA followed by hardwood treated with NAA (0.932 g) (Table 3). This observation may be influenced by the age of the plant part from which the cuttings were taken. Generally, cuttings treated with NAA had high percentage moisture content than cuttings without NAA treatment. Hardwood cuttings treated with NAA recorded the highest percentage moisture content (0.371 g) followed by semi-hardwood (0.312 g) and soft wood (0.230 g) (Table 3). This result may imply that the NAA application may have induced sufficient roots that facilitated the absorption of water and nutrients from the soil medium. This agrees with the findings of Uniyal et al. (1993) who reported that the higher the number of roots developed the by the cuttings the more they can absorb sufficient water and nutrients to cause an increase the growth of the aerial portion of the plant.

CONCLUSION

The study showed significant variability in root and shoot development of *L. inermis* cuttings taken at different physiological stages of the plant. Hard wood cuttings recorded higher number of sprout and roots and most effective as propagation material for *L. inermis*. NAA had significant effect of root development of both soft wood and semi-hard wood cuttings except in hardwood cuttings where cuttings developed adequate roots without hormone application. Vegetative propagation by hard wood stem cutting without plant growth regulators seem to be feasible for *L. inermis*.

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