Academic Journal of Plant Sciences 5 (3): 84-89, 2012
ISSN 1995-8986

DOI: 10.5829/idosi.ajps.2012.5.3.2021

Cultivation Technique of an Important Medicinal Plant *Gymnema sylvestre* R. Br. (Gurmar)

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Abstract: *Gymnema sylvestre* R.Br. is an important medicinal plant which grows wild in the tropical forests of central, western and southern India and in the tropical areas of Africa, Australia and China. Due to increase in demand and destructive harvesting, the plant has become vulnerable. Field experiments were conducted during 2004 to 2007 to develop some important aspects of cultivation techniques of the species. Different experiments were carried out to standardize seed germination, vegetative propagation and cultivation practices of the species. The study revealed that the species can be cultivated successfully by seeds as well as by rooted cuttings at a spacing of 50 x 50 cm. It was observed that pretreatment of seeds in cold water for 24 h improves the seed germination. For vegetative propagation, hard wood cuttings of 10-15 mm diameter having three nodes were found most suitable. March and July was found the best time for vegetative propagation. Among hormonal treatments, dipping of cuttings in 500 ppm IBA solution for 30 min was suitable for maximum rooting (52.50%). Application of 4000 kg FYM/ha was found promising in terms of growth and yield. Total yield of dry leaves was found to be 1.5 tones/ha. The crop became ready for harvest after two years of plantation and harvesting can be done twice a year in the months of October and June.

Key words: Gudmar · Cultivation · Germination · Propagation · India

INTRODUCTION

Gymnema sylvestre (Gudmar) is an important medicinal woody climber belonging to family Asclepiadaceae. In India, it is found growing in the forests of Andhara Pradesh, Bihar, Chhatisgarh, Karnataka, Kerala, Madhya Pradesh, Maharastra, Orissa, Tamil Nadu, Uttar Pradesh and West Bengal. The leaves are simple, opposite, elliptic or ovate and hairy; the flowers are small, yellow and in umbellate cymes; the follicles are terete, lanceolate and upto 7.5 cm in length.

The species is extensively used in almost all the Indian system of medicine as a remedy for rheumatism, cough, ulcer, pain in eyes, dyspepsia, jaundice, haemorrhoids, asthma, bronchitis, conjunctivitis, leucoderma etc. [1]. Roots are used as a remedy for snakebite. It is also used as stomachic, diuretic and remedy to control diabetes mellitus [2]. The leaves of this plant are in use for over 2000 years to treat diabetes, giving it a prominent place in the indigenous system of medicines in the country. The plant is popularly known as 'Gudmar' for its distinctive property of temporarily destroying the taste of sweetness. Administration of its leaves lowers the blood glucose level in diabetic patients [3]. The anti-diabetic property of the plant is attributed to the presence of mixture of tri-terpines and saponins (gymnemic acids, gymnemagenin and gurmarin) in the leaves. Anti-allergic, antiviral, lipid lowering and other effects are also reported [4, 5]. Gudmar leaves are used in food additives against obesity and caries [6]. Because of multifarious use there is continuous demand of the species which has made it highly vulnerable in nature.

The World Health Organisation (WHO) considers that the quality of raw materials and finished products depend on many factors including cultivation techniques, collection methods, harvesting methods, post-harvest processing, transport and storage practices. WHO prescribed general guidelines for good cultivation and collection practices (GACP) for supply of quality medicinal herbs [7].

G. sylvestre is the second best selling medicinal plant in the world market requiring a cost-effective and simple method of cultivation to meet its growing demand. The availability of the species in natural forests is

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decreasing very fast due to over and unsustainable harvesting. Present demand is mostly met from wild collection. Therefore, the only way to meet the increasing demand and reduce the pressure of harvest from wild is its large scale cultivation. The present study was, therefore, undertaken to study important aspects of cultivation techniques with special reference to seed pretreatment, seed germination, vegetative propagation, plantation and influence of application of manure on growth and yield.

MATERIALS AND METHODS

Plant Material: Mature *G. sylvestre* fruits (follicles) were collected from different forest areas including Amarkantak, Chatarpur, Chitrakoot, Mandla, Panna and Seoni of Madhya Pradesh, India. Stem cuttings were also collected from the above locations and planted in Non Wood Forest Produce nursery of the institute.

Seed Germination: The seeds were extracted from the fruits and subjected to following pretreatments (25 seeds per treatment in 7 replications) before sowing in order to facilitate germination.

T_0 : Control (no pretreatment)
T_1 : Soaking in cold water (20-25°C) for 24 h
T_2 : Soaking in hot water for 10 minutes

After pretreatment seeds were sown on 15th May 2004 in already prepared nursery beds filled with sand, soil and Farm Yard Manure (FYM) in ratio of 2:1:1. Seeds were sown at a depth of 1.5 to 2.5 cm in the bed. The nursery beds were watered daily and the seeds germinated in about 21 days. After 35-45 days seedlings were transferred to polythene bags containing a mixture of soil, sand and FYM mixed in equal proportion. Data on germination percentage were recorded.

Vegetative Propagation: Three different experiments were conducted to study rooting response with application of hormone, without application of hormone and propagation time. For this purpose various types of branch cuttings viz., soft wood cuttings (0-5 mm diameter), semi hardwood cuttings (6-10 mm diameter) and hardwood cuttings (11-15mm diameter) of 12-15 cm length were collected from the plants growing in the NWFP nursery of the institute. The cuttings were prepared with 2-4 nodes.

Without Hormone: The cuttings so prepared were placed for rooting without application of hormone, in trays filled with cleaned riverbed sand. The experiment was conducted with fifty cuttings per treatment with eight replications in a randomized block design. Trays were kept moist by regular watering. Data on rooting percentage was recorded.

With Hormone: Fresh cutting of 12-15 cm length with 2-4 nodes having diameter 11-15 mm were prepared. Lower end of cuttings were dipped for 30 min in different concentrations of rooting hormones viz. IBA 100 ppm, IBA 200 ppm, IBA 500 ppm, IBA 1000 ppm, IAA 100 ppm, IAA 200 ppm, IAA 500 ppm, IAA 1000 ppm. The upper end of cuttings was sealed with paraffin wax. The treated cuttings were planted with at least one node below the sand surface in trays filled with cleaned river bed sand. Twenty cuttings were planted in each treatment with five replications in a randomized block design. The trays were kept moist by providing regular watering. Periodic observations were recorded. The rooting and survival percentage was calculated. On completion of 3 months, the plantlets raised in trays were transferred to polybags of size 16 cm x 9 cm filled with soil, sand and FYM in ratio of 1:1:1.

Propagation Time: To find out best time of propagation, 12-15 cm cuttings having 2-4 nodes collected from the plants growing in the institute nursery and planted at monthly intervals in the trays filled with sand. Twenty cuttings were planted in each treatment with three replications in randomized block design. No hormonal treatment was given to the cuttings. The trays were kept moist by giving regular watering. Observations were recorded on rooting percentage.

Influence of Organic Manure on Growth

Land Preparation and Planting: The experimental field was ploughed and leveled properly, 30 cm^3 sized pits were dug at a distance of 50 cm between the rows and 50 cm between plants (within the row). The pits were dug open 30 days earlier to planting. Plantlets raised by rooted stem cuttings were planted in the pits on 24th July 2004. The soil of the experimental field is sandy loam having pH of 7.6. No chemical fertilizers and pesticides were used in raising and managing the plantations.

Manures: The trial was laid out in randomized block design with five replications and four different treatments (T_o-control, T_1-FYM 10 kg/plot, T_2-vermicompost 5kg/plot,

T_3 -green manure 10kg/plot) in 5x5m plot. The data on plant growth and leaf yield was recorded at regular intervals. The leaves were selectively harvested in 2nd year of planting. Fresh and dry weights of the leaves were taken from the leaves collected from five selected sample plants from each treatment plot.

Support System: *G. sylvestre* is a climber in nature and require proper support for better growth and development. In the present case support system was made up of bamboo poles. The two main stems were trained on opposite directions for proper spread. Care was taken to see that the climber did not fall on to the ground. Irrigation.

The crop was irrigated after planting for better establishment of plantlets. The plants were irrigated fortnightly during summer months and monthly during winter months. However, no irrigation was provided during rainy season.

Weeding and Hoeing: Periodical weeding and hoeing was done during and after rainy season. On proper establishment of plants weeding was done on quarterly intervals.

Statistical Analysis: The data was subjected to statistical analysis through one way ANOVA using SX statistical software (PC DOS Version 2.0 NH Analytical Software).

RESULTS AND DISCUSSION

Seed Pretreatment and Germination: Data on effect of pretreatment on germination percentage is presented in Table 1. In general, seed germination was poor but it was significantly affected by pretreatments which varied from 28.50 - 42.50 percent. Highest germination was obtained when seeds were soaked in cold water for 24 hours. Propagation of *G. sylvestre* through seed is not easy due to difficulty in seed availability and prevailing dormancy problem [8]. Sari *et al*. [9] observed that presoaking of seeds for 24 h improved germination compared to other treatments like moistening the seeds, presumably allowing increased water imbibitions. Arunakumara and Subasinghe studied the dynamics of seed germination of *G. sylvestre* and also reported that availability of high moisture content increases germination response [10]. Our finding suggests that simple treatment of cold water (for 24 h) helps in breaking seed dormancy and improves germination.

Table 1: Effect of pretreatment on seed germination of *Gymnema sylvestre*

Treatment	Germination percentage
T_0 (Control)	28.50
T_1 (Cold water 24 hours)	42.50
T_2 (Hot water 10 minutes)	38.35
± SE	0.04
CD at 5%	0.97

Vegetative Propagation: The observations revealed higher rooting success (52%) in hardwood cuttings followed by semi hardwood and soft wood cuttings (26% and 15% respectively) without any hormonal treatment (Table 2). The propagation of *G. sylvestre* through rooted cuttings is preferred due to short supply and dormancy problems in seeds [8]. Hardwood cutting had higher potential of root production and success rate is high in rooting of *G. sylvestre* when stem cuttings are placed with at least one node inside the planting medium [11].

Rooting Hormones: The influence of rooting hormones on sprouting, rooting and survival were recorded and presented in Table 3. Though sprouting was noticed (after 8 days) in all the treatments, after 2 weeks the young leaves withered away in cuttings which failed to root. Root initiation was observed after 18 days of planting. Cuttings which survived were found to have developed callus from which young adventitious roots emerged and established well. Out of 50 cuttings planted with one node below the soil surface, 26 were rooted successfully. On the other hand, those without any node below the soil surface did not root. Our findings revealed that cuttings dipped in 1000 ppm IBA solution for 30 min exhibited

Table 2: Effect of cutting diameter in rooting of *Gymnema sylvestre*

Treatment	No. of cuttings	No. of cuttings rooted	Rooting percentage
1. Cuttings having diameter 0- 5 mm (soft wood cuttings)	300	45	15
2. Cuttings having diameter 5- 10 mm (semi hard wood cuttings)	300	78	26
3. Cuttings having diameter 10-15 mm (hard wood cuttings)	300	156	52
± SE		0.50	0.63
CD at 5%		1.07	1.45

Table 3: Effect of hormones on rooting of *Gymnema sylvestre*

Treatment	Sprouting (%)	Rooting (%)	Survival (%)
T_0 Control	55.00	19.50	18.67
T_1 (IBA 100 ppm)	71.50	25.33	23.63
T_2 (IBA 200 ppm)	72.50	36.63	36.00
T_3 (IBA 500 ppm)	71.17	52.50	40.67
T_4 (IBA 1000 ppm)	77.87	32.67	32.23
T_5 (IAA 100 ppm)	63.17	26.83	25.70
T_6 (IAA 200 ppm)	68.17	25.13	24.30
T_7 (IAA 500 ppm)	75.17	30.73	29.97
T_8 (IAA 1000 ppm)	70.83	38.00	35.17
± SE	5.31	1.79	1.60
CD at 5%	NS	3.79	3.39

Table 4: Monthly variation in sprouting, rooting and survival of *Gymnema sylvestre*

Month	Sprouting (%)	Rooting (%)	Survival (%)
January	56.4	26.5	22.4
February	63.0	31.5	27.8
March	89.6	44.5	39.4
April	66.8	33.5	28.5
May	52.4	27.6	24.4
June	62.0	29.2	23.5
July	89.4	41.5	37.4
August	82.2	25.7	22.6
September	83.5	23.2	22.2
October	48.6	22.5	16.0
November	55.2	26.4	22.5
December	51.4	18.5	18.2
± SE	7.81	1.45	2.58
CD at 5%	12.52	3.45	6.85

Table 5: Effect of different manures on growth of *Gymnema sylvestre*

	4 months						8 months						12 months					
Treatments	Height (cm)	Collar Dia (mm)	No. of Br.	No. of leaves	Fresh wt. (g)	Dry wt. (g)	Height (cm)	Collar Dia (mm)	No. of branches	No. of leaves	Fresh wt. (g)	Dry wt. (g)	Height (cm)	Collar Dia (mm)	No. of Branches	No. of leaves	Fresh wt. (g)	Dry wt. (g)
T_o	67.94	5.4	4.46	114	13.45	4.8	113.3	6.56	10.25	204.2	24.74	9.77	150.0	7.71	9.8	211.8	28.14	10.25
T_1	101.6	5.04	5.98	119.2	23.55	8.55	162.4	7.5	9.92	280.2	46.74	17.15	186.1	8.10	10.54	378.6	50.49	18.28
T_2	88.64	5.92	5.64	197.8	23.12	8.52	156.6	7.2	11.48	319.4	36.81	13.56	185.5	8.19	13.64	356.0	40.83	15.64
T_3	70.14	5.60	5.10	153.2	18.24	6.70	141.0	7.4	9.58	235.6	30.04	11.30	159.8	7.85	9.98	240	27.47	10.85
± SE	0.32	NS	0.16	3.12	0.50	0.41	0.52	0.20	0.70	0.81	1.48	0.68	0.46	0.96	1.56	0.90	0.50	0.14
CD at 5%	0.83		0.43	6.81	1.21	0.92	1.26	0.46	1.54	1.83	3.23	1.48	1.12	2.14	3.42	1.97	1.28	0.32

T_o - (Control), T_1 - (FYM 10 kg/plot), T_2 - (vermicompost 5 kg/plot), T_3 - (Green manure 10 kg/plot)

highest sprouting (77.87%); however rooting (52.50%) and survival (40.67%) was highest in 500ppm IBA solution. Karoshi and Hedge have suggested 2500 ppm IBA treatment to improve the rooting ability of apical shoot cuttings in *G. sylvestre* [12]. There was significant difference in rooting pattern of *G. sylvestre* cuttings among treatments as hormones enhanced out-of-season rooting. The present study suggests that stem cuttings of *G. sylvestre* treated with IBA 500 ppm with at least one node buried inside the planting medium have better success in propagation.

Propagation Time: Table 4 represents the influence of time (season) on propagation of *G. sylvestre*. The cuttings sprouted every month and sprouting percentage varied from 51.4 - 89.6% whereas rooting percentage varied from 18.5 - 44.5%. March was found to be the best month for planting of *G.sylvestre* cuttings as it showed maximum sprouting (89.6%) and rooting (44.5%). July was also found to be equally good for the purpose. The lowest rooting was observed in the cuttings planted in the month of December (18.5%). Seasons affected rooting due to the changes of environmental conditions (temperature, light),

which had a direct influence on the physiology of the stock plants and on the rooting capacity of the cuttings themselves. March and July was the best period to obtain optimal rooting of cuttings.

Growth Performance: The data pertaining to influence of manures on plant growth and yield are presented in Table 5. Maximum height (186.10 cm) was recorded with the treatment T_1 where 10 kg FYM/per bed was applied. However, maximum collar diameter (8.19 mm) and number of branches (13.64) were recorded with the treatment T_2 (5 kg vermicompost/bed). The results further revealed that treatment T_1 was found superior among other treatments as it yielded higher number of leaves (378.6), maximum fresh (50.49 g) and dry weight (18.28 g) from 12 months crop. As compared to control, numbers of leaves, fresh and dry weight were 1.78, 1.79 and 1.78 folds higher in T_1 treatment respectively. The results also showed that the percent increase in the leaf yield of *G. sylvestre* was recorded highest in the treatment T_1 followed by the treatment T_2. The results revealed that the plants attained maximum growth during 8-12 months after plantation. Different forms of organic manure had a significant effect on fresh and dry weights of *G. sylvestre* leaves. However, there was no significant influence on growth attributes like height, collar diameter and number of branches. Also the growth attributes under different treatments is indicative of best manure required for the production of organically grown *G. sylvestre* leaves. The study has provided manure requirement for better growth of the plant. Application of FYM appeared most promising; however, vermicompost was found at par with the FYM. In an earlier study Tanuprakash and Adholeya reported that the biomass yield was influenced by application of organic manures [13].

Harvesting and Yield: The crop was ready for harvest after two years of planting. Leaves are the economic part and the harvesting of the leaves was done twice in the year. First harvest was done when the plant started flowering, i.e. during June and second harvest was done in September-October. Leaves were harvested by hand plucking and the main stem was not cut during harvest of leaves unlike the prevailing practice. The harvested leaves were dried under shade by allowing sufficient air to circulate by spreading thinly on clear ground for about 7-8 days. Direct sunlight was avoided to maintain quality of the leaves. Total yield of dry leaves was found to be 1.5 tones/ha.

CONCLUSION

G. sylvestre grows well in tropical and sub-tropical type of climate. It can be grown on a variety of soils in different agro-climatic zones. The plant is sensitive to water logging and hence its cultivation on such soil should be avoided. On the basis of our findings, the following facts are endorsed for cultivation of *G. sylvestre*.

- To increase germination, seeds should be pretreated with cold water for 24 hours and sown in nursery beds having sand, soil and FYM in the ratio of 2:1:1 in the month of May.
- For vegetative propagation, hard wood cuttings of 10-15 mm diameter having three nodes were found most suitable. March and July was found the best time for vegetative propagation. Among hormonal treatments, dipping of cuttings in 500 ppm IBA solution for 30 min was suitable for maximum rooting (52.50%).
- 4000 kg FYM per ha should be applied for better growth and higher production. Regular weeding, hoeing and irrigation should be done for proper management of crop. For better growth and development of climber, proper support system should be provided preferably using locally available material to reduce cost of cultivation.
- Harvesting should be done after two years of plantation by hand plucking the leaves, twice in a year (June and October).

ACKNOWLEDGEMENT

This work was supported by a grant from the National Medicinal PLants Board, Govt. of India New Delhi. We thank the Madhya Pradesh Forest Department for permission of work in different forest areas.

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