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Effect of organic fertilisers on the yield and quality of giloy (*Tinospora cordifolia*) in Jharkhand

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ABSTRACT

Tinospora cordifolia *(Willd.) Hook. f. and Thoms. is an important medicinal plant belonging to the family Menispermaceae that is used in Ayurveda to improve the immune system and the body's resistance against infections. The experiment was conducted at the Botanical Garden, PG Department of Botany, Vinoba Bhave University, Hazaribag, to determine the effect of organic fertilisers on the yield of* Tinospora cordifolia. *The plants of* Tinospora cordifolia *were planted in Randomized Block Design (RBD) with 12 treatments replicated three times. The seedling plant was transplanted in February 2021 on a plot size of 2 m x 2 m with a spacing level of 100 cm x 100 cm. The number of plants in each treatment was four. Farm Yard Manure (FYM), Vermicompost, Sunflower Cake (SC), Mahua Cake (MC), Linseed Cake (LC), Karanj Cake (KC), Mustered Cake (MC), Neem Cake (NC), Azotobactor, and Tricoderma were used as organic fertilisers for application in all treatments. The useful part of this plant is the stem, and the effectiveness of its medicinal value depends upon its thickness. The objective of this research was to find out the effect of organic fertiliser on the yield of* Tinospora cordifolia *in Jharkhand. Maximum significant stem yield per hectare (16781.00 kg/ha), dry stem yield per hectare (10695.42 kg/ha**),** and percentage of Giloy-satva (3.71%) were recorded from Treatment-7 (Application of Linseed Cake: 5 t ha^{-1}). Linseed cake is the best organic fertiliser for the cultivation of Giloy. It will be significant to the farmers and medicinal plant growers interested in the commercial cultivation of* Tinospora cordifolia *in Jharkhand.*

Key words: Giloy, *Tinospora cordifolia,* Organic fertilizers, Cake, Yield, Giloy-satva.

INTRODUCTION

Tinospora cordifolia (Willd.) Hook. f. and Thoms. *(*Guduchi*)* is a large, glabrous, deciduous climbing shrub belonging to the family Menispermaceae **(**Aima, 2003; Vaidya, 1994**).** It is one of the important dioecious plants distributed throughout the tropical Indian subcontinent and China, ascending to an altitude of 300 m. In Hindi, the plant is commonly known as Giloy **(**Bhandari, 2006**),** which is a Hindu mythological term that refers to the heavenly elixir that has saved celestial beings from old age and kept them eternally young. The plant is known as Amrita, and the term is attributed to its ability to impart youthfulness, vitality, and longevity to the consumer. *Tinospora cordifolia* is traditionally used for the treatment of asthma, and the juice is also employed for the treatment of chronic coughs **(**Spelman, 2001**).** Guduchi has been well researched for its immune-modulatory activities for many years. A variety of constituents have been isolated from *Tinospora cordifolia.* They belong to different classes, such as alkaloids, diterpenoid lactones, aliphatic compounds, clerodane, miscellaneous compounds, polysaccharides, etc. Due to the presence of acidic soil in most of the areas of Jharkhand, the micro- and macronutrients of the soil are not available for plants; therefore, the growth of plants is affected. The application of organic fertilisers would provide an environment to improve the physical and chemical properties of the soil. The main aim of this research was to find out the effect of organic fertiliser on the stem yield and percentage of Giloy-satva of *Tinospora cordifolia* in the soil of Jharkhand.

MATERIALS AND METHODS

The experimental site is located in the Botanical Garden of Vinoba Bhave University, Hazaribag (Jharkhand), which is located between 23.9933° N latitude and 85.3620° E longitude. The temperature varies from 24.4^{0}C to 39.2^{0}C and humidity varies from 10.8% to 98.3%. The annual rainfall in Hazaribag district is 1255 mm. The altitude is about 610 m above the mean sea level. Due to the presence of iron in the soil, the soil is red at the study site. The

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soil colour of the study area is a little red, brown, and yellow.The experiment was laid out in Randomized Block Design with 12 treatments and 3 replications by following the procedure outlined by Panse and Sukhatme (1985). Farm Yard Manure (FYM), Vermicompost, Sunflower Cake (SC), Mahua Cake (MC), Linseed Cake (LC), Karanj Cake (KC), Mustered Cake (MC), Neem Cake (NC), Azotobactor, and Tricoderma were used as organic fertilisers for application in all treatments. Four plants per treatment were transplanted in a plot size of 2 m x 2 m at spacing of 100 cm x 100 cm on 11th April, 2021.

Photos 1: Experimental plots at Botanical Garden, V.B.U. Hazaribag, Jharkhand, India

Details of treatments were T_1 – Control, T_2 - Farm Yard Manure (FYM): 10 t ha^{-1} (recommended); T_3 - Farm Yard Manure (FYM): 5 t ha^{-1}, T_4 - Vermicompost: 5 t ha^{-1}, T_5 - Sunflower Cake: 5 t ha^{-1}, T_6 - Mahua Cake: 5 t ha^{-1}, T_7 - Linseed Cake: 5 t ha^{-1}, T_8 - Karanj Cake: 5 t ha^{-1}, T_9 - Mustered Cake: 5 t ha^{-1}, T_{10} - Neem Cake: 5 t ha^{-1}, T_{11} - Azotobactor: 5 g/plant, and T_{12} - Tricoderma: 5 g/plant. Irrigation was given as per the requirements of the crop. The stem of the Giloy was harvested after 20 months of transplantation during the month of December, 2022. The data was subjected to ANOVA analysis, and critical difference values will be tabulated at the five percent level of significance of the corresponding degree of freedom.

Extraction of *Giloy-satva* from the Giloy stem

Giloy stems were collected and washed thoroughly with potable water. A known quality of fresh Giloy stem of 1.6–2.0 cm thick was taken from each treatment as mentioned above and chopped into pieces of 1.5–2.0 inches in length. These pieces were then pounded thoroughly and converted into a slimy paste. The mass so obtained was kept for soaking overnight (12 hour) in six times more potable water in a cylindrical flask of glass.

The next morning, the mass was macerated in water thoroughly with hands for about 45 minutes and filtered slowly through a clean cotton cloth folded four times. The liquid was kept aside undisturbed for 4 hours; thereafter, the supernatant liquid was carefully siphoned off. White and smooth starchy sediment settled at the bottom was collected into a Petri dish, air-dried under a running fan, and stored in a dry, airtight, small-size polythene bag under sterile conditions (Sharma *et al.*, 2015).

Fig.: Procedure for preparation of *Giloy-satva*

RESULTS AND DISCUSSION

The study was carried out to determine the impact of organic fertilisers on the yield and percentage of *Giloy-satva* in the stems of the Giloy plants. Data were recorded during 2022–23 on different parameters and statistically analysed for the validation of the results.

Fresh stem yield (Kg/plant) and Fresh stem yield (Kg/ha) of Giloy plants

As shown in Table 1, the maximum significant fresh stem yield per plant (1.68 kg/plant**)** of Giloy was recorded in treatment 7 (Linseed Cake: 5 t ha^{-1}) and the minimum (0.88 kg/plant**)** was in treatment 8 (Karanj Cake: 5 t ha^{-1}). Maximum highly significant fresh stem yield per hectare (16781.00 kg/ha) was recorded from Treatment-7 (Linseed Cake: 5 t ha^{-1}) followed by 12137.67 kg/ha (T_{12}-Tricoderma: 5 gm/plant) 11897.00 kg/ha (T_{12}-Azotobactor: 5 g/plant), 11874.33 kg/ha (T_2-FYM: 10 t ha^{-1}), and the lowest (8752.33 kg/ha) was recorded in Treatment-8 (Karanj Cake: 5 t ha^{-1}) whereas the grand mean value was 10862.75 kg/ha.

Table 1: Fresh stem yield per plant (kg/plant) Fresh stem yield (kg/ha) and dry stem yield (kg/ha) of Giloy plants

Treatments	Treatments Detail	Fresh stem yield per plant (kg/plant)	Fresh stem yield (kg/ha)	Dry stem yield (kg/ha)
T_1	Control	0.99	9862.67	6391.27
T_2	FYM: 10 t ha^{-1}	1.19**	11874.33*	7594.31**
T_3	FYM: 5 t ha^{-1}	1.06	10635.67	6925.19
T_4	Vermicompost: 5 t ha^{-1}	0.89	8904.00	5726.70
T_5	Sunflower Cake: 5 t ha^{-1}	0.91	9138.00	5908.45
T_6	Mahua Cake: 5 t ha^{-1}	0.99	9916.33	6296.47
T_7	Linseed Cake: 5 t ha^{-1}	1.68**	16781.00**	10695.42**
T_8	Karanj Cake: 5 t ha^{-1}	0.88	8752.33	5524.18
T_9	Mustered Cake: 5 t ha^{-1}	0.95	9453.67	5984.37
T_{10}	Neem Cake: 5 t ha^{-1}	1.10	11000.33	6965.49
T_{11}	Azotobactor: 5 gm/plant	1.19**	11897.00*	7481.13
T_{12}	Tricoderma: 5 gm/plant	1.21**	12137.67**	7646.86**
	Grand Mean	1.07	10862.75	6928.32
	SEM	0.05	468.99	276.93
	CD at 5%	0.10	955.14	563.10
	CD at 1%	0.11	1113.54	657.52
	CV %	7.48	7.48	6.92

Maximum highly significant dry stem yield per hectare (10695.42 kg/ha) was recorded from Treatment-7 (Linseed Cake: 5 t ha^{-1}) followed by 7646.86 kg/ha (T_{12}- Tricoderma: 5 gm/plant) and 7594.31 kg/ha (T_2- FYM: 10 t ha^{-1}) while the minimum (5524.18 kg/ha) was recorded from Treatment-8 (Karanj Cake: 5 t ha^{-1}) whereas the grand mean value was 6928.32 kg/ha. Shimrayngayung (2008) revealed the yield parameters like the shoot fresh weight and dry weight (30.98 g and 9.46 g, respectively) were recorded highest in castor cake at 6 t ha^{-1} + 50% RDF + phosphorus solubilizing bacteria at 2 kg ha^{-1} + *Azospirillum*at 2 kg ha^{-1}, which was followed by vermicompost at 15 t ha^{-1} + 50% RDF + phosphorus solubilizing bacteria at 2 kg ha^{-1} + *Azospirillum*at 2 kg ha^{-1} (28.14 g and 9.07 g, respectively).

Percentage of Giloy-satva (%) and Yield of Giloy-satva (Gm/plant)

Fresh Giloy stems would be chosen for the study purpose (Shastri *et al.,* 2005). Among all parameters, the percentage of Giloy-satva was the most important parameter because of its use in various diseases. Table 2 showed that the maximum percentage of Giloy-satva (3.71%) of the stem of Giloy (*Tinospora cordifolia*) was calculated from treatment 7 (Linseed Cake: 5 t ha^{-1} followed by 3.65% in T_2 (FYM: 10 t ha^{-1}), 3.62% in T_{11} and T_{12} (T_{11}- Azotobactor: 5 g/plant and T_{12}- Tricoderma: 5 g/plant). The lowest percentage of Giloy-satva (3.30%) was recorded in T_8 (Karanj Cake: 5 t ha^{-1}) followed by 3.31% in T_1 (Control), as shown in Grapg 1. Whereas the grand mean of 'Giloy-satva' was 3.50 percentages. Sharma *et al.,* (2012**)** reported that the maximum yield of Satva was 2.7 % from medium-sized (1.6–2.0 cm) fresh stems. There are so many factors, such as differences in species, thickness of stem, time of collection, maturity of plant, ect. that may be responsible for such variations. Sharma *et al.,* (2013) also reported that the average percentage of *Guḍūci Sattva* obtained from 15 batches is 3.8%.

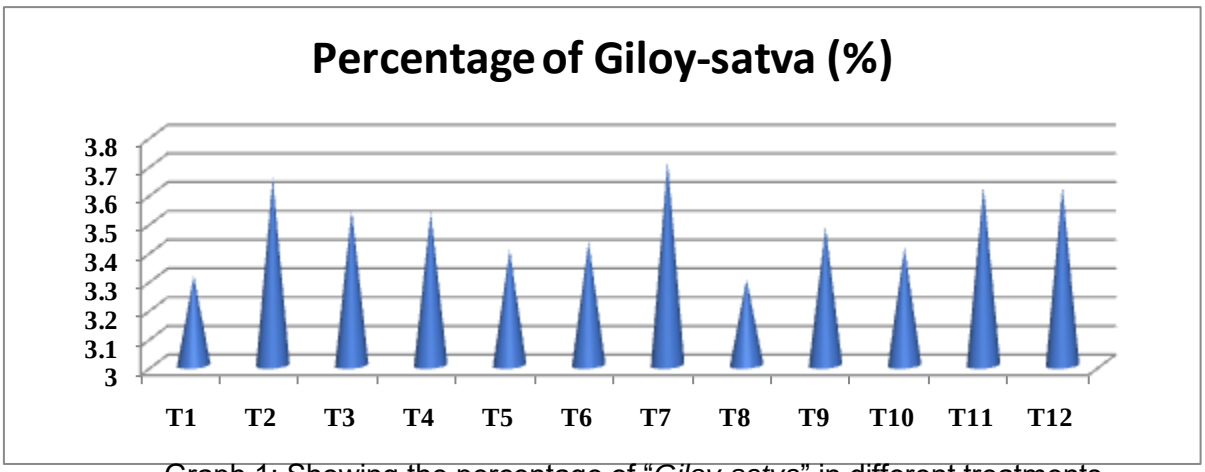
Table 2: Percentage of Giloy-satva (%) and Yield of Giloy-satva (Gm/plant) of Giloy plants

Treatments	Treatment details	Percentage of Giloy-satva (%)	Yield of Giloy-satva (g/plant)
T_1	Control	3.31	32.65
T_2	FYM: 10 t ha^{-1}	3.65**	43.29**
T_3	FYM: 5 t ha^{-1}	3.54	37.69
T_4	Vermicompost: 5 t ha^{-1}	3.53	31.41
T_5	Sunflower Cake: 5 t ha^{-1}	3.40	31.13
T_6	Mahua Cake: 5 t ha^{-1}	3.43	34.00
T_7	Linseed Cake: 5 t ha^{-1}	3.71**	62.37**
T_8	Karanj Cake: 5 t ha^{-1}	3.30	28.83
T_9	Mustered Cake: 5 t ha^{-1}	3.48	32.85
T_{10}	Neem Cake: 5 t ha^{-1}	3.41	37.54
T_{11}	Azotobactor: 5 gm/plant	3.62*	43.04**
T_{12}	Tricoderma: 5 gm/plant	3.62*	43.96**
	Grand Mean	3.50	38.229
	SEM	0.058	1.839
	CD at 5%	0.118	3.746
	CD at 1%	0.138	4.367
	CV %	2.878	8.333

Maximum '*Giloy-satva*' yield per plant **(**62.37 g/plant) was recorded in treatment 7 (Linseed Cake: 5 t ha^{-1}) followed by 43.29 g/plant in treatment 2 (FYM: 10 t ha^{-1}), 43.96 g/plant in treatment 12 (Tricoderma: 5 g/plant), 43.04 g/plant in treatment 11 (Azotobactor: 5 g/plant), and the minimum (28.83 g/plant) was recorded in treatment 8 (Karanj Cake: 5 t ha^{-1}), whereas the grand mean was 38.229 g/plant.

Organoleptic Taste of Stem

A light bitter smell of stem was observed in 7 treatments (T_1, T_4, T_6, T_7, T_8, T_{10} and T_{11}) while a bitter smell of stem was observed in 5 treatments (T_2, T_3, T_5, T_9 and T_{12}). The tikta taste of Giloy stem was observed in 2 treatments (T_8 and T_{10}).



Graph 1: Showing the percentage of "*Giloy-satva*" in different treatments

Table 03: Organoleptic Taste of Stem

Parameter	Particulars	No. of germplasms
Odour	Light bitter smell	T_1, T_4, T_6, T_7, T_8, T_{10} and T_{11}
	Bitter smell	T_2, T_3, T_5, T_9 and T_{12}
Taste	Bitter	T_5, T_6, T_7, T_9, T_{11} and T_{12}
	Kashay	T_1, T_2, T_3 and T_4
	Tikta	T_8 and T_{10}

The bitter and kashay taste was observed in 6 treatments (T_5, T_6, T_7, T_9, T_{11} and T_{12}) and 4 treatments (T_1, T_2, T_3 and T_4) respectively. As per classics, Navare (2011) reported that the taste of Giloy-satva is palatable/pleasant but recent experts describe the *Giloy-satva* as slightly bitter (Reddy, 2005**;** Hiremath and Kalpana, 2005). The freshly cut stem surface quickly assumes a yellow tint when exposed to air due to a light yellow-coloured viscous sap that oozes out of the cut surface. This sap has a nauseating bitter taste because of the presence of glycosides (Chopra, 1994; Sharma, 2003).

CONCLUSIONS

From the above results and discussions, it can be concluded that maximum significant fresh stem yield per hectare (16781.00 kg/ha) and dry stem yield per hectare (**10695.42**) were recorded from Treatment-7 (Linseed Cake: 5 t ha^{-1}). The percentage of Giloy-satva (3.71%) was also recorded from Treatment-7 (Application of Linseed Cake: 5 t ha^{-1}). Linseed cake is the best organic fertiliser for the cultivation of Giloy. It will be significant to the farmers and medicinal plant growers interested in the commercial cultivation of *Tinospora cordifolia* in Jharkhand.

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