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Research Article

Effect of Integrated Nutrient Management on Growth and Yield of *Gymnema sylvestre* (R.Br.), in Jharkhand (India)

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ABSTRACT

Gymnema sylvestre (R.Br.) is a climber plant commonly called Gudmar belongs to family Apocynaceae is deciduous seed plant. A field experiment was conducted during 2017-2019 at the experimental field of Birsa Agricultural University, Ranchi, Jharkhand (India) to find out the integrated nutrient management technique for increasing the yield of the leaf of Gymnema sylvestre (R.Br.). The experiment was laid out in a Randomized Block Design with 12 treatments and one control replicated thrice. Nine plants were transplanted in each treatment at 80 cm x 80 cm spacing level. It is an important medicinal plant used as an herbal remedy for high blood sugar (type-II diabetes). The optimum doses of organic and inorganic fertilizer combination should be 10t ha^{-1} VC+10t ha^{-1} NC+5t ha^{-1} KC +30:40:40 kg NPK ha^{-1} for the maximum productivity of leaves and stem of Gudmar. The combination of organic and inorganic is superior to the application of fertilizer alone and controls for achieving higher growth and yield.

Keywords: *Gymnema sylvestre, organic, inorganic, fertilizer.*

INTRODUCTION

Gymnema sylvestre (R.Br.) is an important medicinal plant that belongs to the Apocynaceae family. It is a vulnerable species, slow growing, and perennial, woody climber medicinal plant. It grows in tropical forests of central, western and southern India (Chandraker, 2014). It is an antidiabetic plant and is used in folk, ayurvedic and homoeopathic systems of medicine. The leaves of Gudmar plant are used for inhibiting the taste of sweetness and are used in the control of diabetes, as a stomachic, diuretic and cough suppressant activity. The fresh leaves, when chewed, have the remarkable property of paralysing the sense of taste for sweet and bitter substance for some time (Warrier et al., 1995). It's leave mainly constituents of gymnemic acid, gymnema saponins and gymnemasides.

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It is commonly called Gudmar and is used to reduce high blood sugar, mainly for the treatment of type-II diabetes. Its important active ingredient is an organic acid called "Gymnemic acid." The gumar plant is known as a sugar destroyer.

In the world, diabetes patients will rise from 135 million in 1995 to 300 million in the year 2025 (King et al., 1998). The plant is useful in inflammations, hepatosplenomegaly, dyspepsia, constipation, jaundice, haemorrhoids, strangury, renal and vesical calculi, helminthiasis, cardiopathy, cough, asthma, bronchitis, intermittent fever, amenorrhoea, conjuctivitis and leucoderma. The main objective of my research is to find the optimum dose of organic and inorganic combination for better plant growth and the maximum foliage yield.

MATERIALS AND METHODS

The experiment was conducted from February 2018 to November 2019 at Birsa Agricultural University, Ranchi's experimental field (D-Block). The university is located between 23° 26 N latitude and 85° 19 /E longitude, about 622 m above the mean sea level.

The experiment was laid out in Randomized Block Design with 12 treatments and one control in three replicates. Number of plants in each treatment was 09. Growth and yield parameters like plant length (cm), collar diameter (mm), number of branches, leaf length and breadth, stem yield, foliage yield etc. were recorded as per NBPGR format (Singh et al., 2003) at different growth stages. The treatments were controlled and a combination of organic and inorganic fertilizers.

Table-1: Details of treatments

Treatment	Treatment details
T_1	Control
T_2	5 t ha^{-1} VC + 5 t ha^{-1} KC + 5 t ha^{-1} NC + 30:40:40 kg NPK ha^{-1}
T_3	7.5 t ha^{-1} VC + 7.5 t ha^{-1} KC+7.5 t ha^{-1} NC + 40:50:40 kg NPK ha^{-1}
T_4	10 t ha^{-1} VC + 10 t ha^{-1} NC + 10 t ha^{-1} KC + 50:50:50 kg NPK ha^{-1}
T_5	5 t ha^{-1} VC + 7.5 t ha^{-1} NC + 10t ha^{-1} KC + 30:40:40 kg NPK ha^{-1}
T_6	5 t ha^{-1} VC + 7.5 t ha^{-1} NC + 10 t ha^{-1} KC + 40:50:40 kg NPK ha^{-1}
T_7	5 t ha^{-1} VC + 7.5 t ha^{-1} NC + 10 t ha^{-1} KC + 50:50:50 kg NPK ha^{-1}
T_8	7.5t ha^{-1} VC + 5 t ha^{-1} NC + 7.5 t ha^{-1} KC + 30:40:40 kg NPK ha^{-1}
T_9	7.5 t ha^{-1} VC + 5 t ha^{-1} NC + 7.5 t ha^{-1} KC + 40:50:40 kg NPK ha^{-1}
T_{10}	7.5 t ha^{-1} VC + 5 t ha^{-1} NC + 7.5 t ha^{-1} KC + 50:50:50 kg NPK ha^{-1}
T_{11}	10 t ha^{-1} VC + 10 t ha^{-1} NC + 5 t ha^{-1} KC + 30:40:40 kg NPK ha^{-1}
T_{12}	10 t ha^{-1} VC + 10 t ha^{-1} NC + 5 t ha^{-1} KC + 40:50:50 kg NPK ha^{-1}
T_{13}	10 t ha^{-1} VC + 10 t ha^{-1} NC + 5 t ha^{-1} KC + 50:50:50 kg NPK ha^{-1}

(VC- Vermicompost, KC- Karanj Cake, NC- Neem Cake)

RESULTS AND DISCUSSION

After one year, the maximum survival percentage (77.78 %) was observed in 5t ha^{-1} VC+5t ha^{-1} KC+5t ha^{-1} NC +30:40:40 kg NPK ha^{-1} where as minimum (55.56%) was recorded in 7.5a^{-1} VC+5t ha^{-1} NC+7.5t ha^{-1} KC +30:40:40 kg NPK ha^{-1} and grand mean of survival percentage was 67.80%. Maximum plant length (369.20 cm) was observed in treatment combination of 5t ha^{-1} VC+7.5t ha^{-1} NC+10t ha^{-1} KC +50:50:50 kg NPK ha^{-1} and minimum was observed in control where as the maximum collar diameter (12.09 mm**)** was recorded in treatment combination of 5t ha^{-1} VC+7.5t ha^{-1} NC+10t ha^{-1} KC +30:40:40 kg NPK ha^{-1} and minimum was in control as shown in Table 2.

Maximum leaf length (6.27 cm) and width (3.47 cm) was reported in treatment combination of 10t ha^{-1} VC+10t ha^{-1} NC+5t ha^{-1} KC +30:40:40 kg NPK ha^{-1} and 5t ha^{-1} VC+5t ha^{-1} KC+5t ha^{-1} NC +30:40:40 kg NPK ha^{-1} respectively whereas the minimum leaf length (5.36 cm) and width (2.72 cm) was

observed in control and 5t ha^{-1} VC+7.5t ha^{-1} NC+10t ha^{-1} KC +40:50:40 kg NPK ha^{-1}, respectively. Manohar et al. (2012) was also analyzed the efficacy of organic and inorganic sources of nitrogen and phosphorus on Growth of Ashwagandha (*Withania somnifera* Dunal). This experiment also showed that the organic and inorganic sources responsible for the better plant growth.

Table-2: Mean values of survival (%), plant length (cm), collar diameter (mm), leaves length & width (cm) and number of branches/plant in different fertilizer treatments of Gudmar

Treatments	Survival %	Plant length(cm)	Collar Diameter (mm)	Length of Leaves (cm)	Width of leaves (cm)	No. of primary branches/plant
T_1	70.37	290.87	9.47	5.36	3.05	3.13
T_2	**77.78**	321.47	11.48	6.13	3.47	3.24
T_3	74.07	347.07	10.14	5.96	2.88	3.33
T_4	70.37	363.33	11.56	5.81	3.35	3.37
T_5	66.67	361.73	12.09	5.86	3.31	3.61
T_6	62.97	362.12	10.00	5.39	2.72	2.80
T_7	74.07	369.20	11.27	5.51	3.05	3.02
T_8	**55.56**	363.17	10.03	5.65	3.09	3.49
T_9	62.96	324.29	11.57	5.65	3.04	4.44
T_{10}	70.37	348.00	10.36	5.43	3.03	2.96
T_{11}	59.19	362.58	10.39	6.27	3.31	3.10
T_{12}	74.08	342.93	10.39	5.50	2.89	2.88
T_{13}	62.96	291.40	9.56	5.51	2.83	3.62
G. Mean	67.80	346.63	10.64	5.70	3.08	3.31
CV %	9.46	13.64	10.05	7.26	12.42	13.76

Fig. 1: Experimental field of Gudmar

The maximum number of branches per plant (4.44) of Gudmar was observed in treatment combination of 7.5t ha^{-1} VC+5t ha^{-1} NC+7.5t ha^{-1} KC +40:50:40 kg NPK $ha^{-1}$where as the minimum (2.80) was in 5t ha^{-1} VC+7.5t ha^{-1} NC+10t ha^{-1} KC +40:50:40 kg NPK ha^{-1} . Muniramappa *et al.* (1997) recorded highest plant height, plant spread, number of branches and number of leaves with the application of 75 kg N, 75 kg P_2O_5 and 50 kg K_2O per ha in Kalmegh (*Andrographis paniculata*).

Fig. 2: Data collection in experimental field

Fig. 3: Harvesting of Gudmar Crop

Table-3: Mean values of Fresh plant weight (Kg/plant), Dry plant weight (Kg/plant), Dry leaves Weight (Kg/ha), and Dry stem weight (Kg/ha) in different fertilizer treatments of Gudmar

Treatments	Fresh plant weight (Kg/plant)	Dry plant weight (Kg/plant)	Dry leaves Weight (Kg/ha)	Dry stem weight (Kg/ha)
1	0.594	0.255	2580.98	1399.31
2	0.788	0.359	3861.61	1752.23
3	0.794	0.325	3523.44	1549.70
4	1.182	0.470	5208.33**	2128.47**
5	0.873	0.408	4348.96	2055.56
6	0.742	0.343	3624.48	1732.64
7	0.952	0.380	4098.96	1831.85
8	0.815	0.349	3563.54	1895.83
9	0.832	0.389	4078.13	2000.87
10	0.769	0.331	3569.94	1596.60
11	0.895	0.427	4546.88	2119.79*
12	0.881	0.398	4301.08	1910.73
13	0.868	0.391	4221.35	1894.79
G. Mean	0.85	0.37	3963.67	1836.03
SEM	0.061	0.0243	321.91	120.76
CD at 5%	0.125	0.049	654.03	245.35
CD at 1%	0.145	0.058	761.37	285.62
CV%	12.57	11.36	14.07	11.39

Maximum weight of fresh individual plant (1.182 Kg) and weight of dry individual plant (0.470 Kg) were recorded in treatment combination of 10t ha^{-1} VC+10t ha^{-1} NC+10t ha^{-1} KC +50:50:50 kg NPK ha^{-1} and all showed highly significant value from control where as the minimum weight of fresh individual plant (0.594 Kg) and weight of dry individual plant (0.255 Kg) were recorded in control. The combination of organic, inorganic and biofertilizers is the superior over application of fertilizer alone for achieving higher growth and yield (Ahmad et al., 2016). NMPB, 2008 was reported that 10–12 tonnes/hectare of FYM or 250 kg of NPK (nitrogen, phosphorus, potassium in equal quantities) is applied as basal dose at the time of land preparation for maximizing biomass production of *Gymnema sylvstre*.

Fig. 4: Separation of leaves from plants

Fig. 5: Weighting of single Gudmar plants

Maximum yield of dry leaves (5208.33 Kg/ha) of Gudmar was recorded in treatment combination of 10t ha^{-1} VC+10t ha^{-1} NC+10t ha^{-1} KC +50:50:50 kg NPK ha^{-1} and showed highly significant difference from grand mean and control. Minimum yield of dry leaves (2580.98 Kg/ha) of Gudmar was recorded in control. Maximum yield of dry stem (2128.47 Kg/ha) of Gudmar was also recorded in treatment combination of 10t ha^{-1} VC+10t ha^{-1} NC+10t ha^{-1} KC +50:50:50 kg NPK ha^{-1} and showed highly significant difference from grand mean and control. Significant dry stem yield difference was noticed in the treatment combination of 10t ha^{-1} VC+10t ha^{-1} NC+5t ha^{-1} KC +30:40:40 kg NPK ha^{-1} from the grand mean. The minimum yield of dry stem (1399.31 Kg/ha) was recorded in control. Application of a mixture of organic sources (cow dung, bone meal and Neem seed cake) + NPK at 28:28:28 g per 1.3 sq.m) resulted in increase in vegetative growth, flowering and fruiting as reported by Maitra et al. (1998) in *Withania somnifera*. Similarly, Maheshwari et al. (2000) conducted field experiment on Ashwagandha at Malwa plateau of Madhya Pradesh, with the application of 2.5 t FYM along with 12.5 kg N + 25 kg P_2O_5 ha-1 recorded 23.7% higher root yield.

CONCLUSION

Based on the above observations, they were recorded during the cropping period. It can be concluded that among the various treatments of Integrated Nutrient Management on the important medicinal plant Gudmar (*Gymnema sylvestre*), the maximum productivity of dry leaves and stem of Gudmar in organic and inorganic fertilizer combination of 10 t ha^{-1} VC + 10 t ha^{-1} NC + 10 t ha^{-1} KC + 50:50:50 kg NPK ha^{-1}. The combined use of organic and inorganic fertilizers recorded a significant maximum production of biomass of Gudmar plants. It was also observed that increased yield of total biomass through increases the soil fertility. Soil fertility could be increased through proper management of soil nutrients.

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There is no such evidence of conflict of interest.

Author Contribution
All authors have participated in critically revising of the entire manuscript and approval of the final manuscript.

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