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Dr. Sindhu Kumari
C/O Dr. VS Prasad, HOD Surgery, DMCH, Laheriasarai, Darbhanga, Bihar, India

Corresponding Author:
Dr. Sindhu Kumari
C/O Dr. VS Prasad, HOD Surgery, DMCH, Laheriasarai, Darbhanga, Bihar, India

Analysis of fertilizer on growth and biomass in *Peganum harmala* a rare medicinal plant

Dr. Sindhu Kumari

Abstract
The present paper deals with its cultivation and application of agro-techniques. Result reveal that seeds sowing a^{+}. 1.0cm in 1:2:1 (sand: clay: FYM) soil mixture ratios were found to be most favourable for maximum seedling emergence. Maximum percent increase in plant height and collar diameter was observed in NPK and biovita plants, respectively. Above and belowground biomass increased signification with NPK application as compared to other treatments.

Keywords: Fertilizer, *Peganum harmala* and Medicinal Plant

Introduction
Peganum Harmold is a rare medicinal plant of the Indian Thar desert. The plant is useful (Hadded *et al*., 2003) [1]. It has narcotic, emetic and antihelmintic properties. Smoke of whole plant relieves from toothache and is also useful in asthma. It is used in the treatment of Jaundice, Fever, colic pains, hysteria and rheumatism.
It stimulates central nervous system (Kumar *et al*., 2005) [2, 11]. The seeds are taken to treat eye disorders and to increase the volume of breast milk production. Seeds have shown anti-toxicity against cancerous cells (Lamchouri *et al*., 2000) [3]. Seeds contain harmine, harmaline and harmols as major bioactive constituents (Mukherjee 2002) [4]. The plant is reported to be rare in Rajasthan (Billore 1989) [5].
Being an important and rate medicinal plant, in the present investigation, an attempt has been made to improve its growth and development as well as biomass production by applying different treatments such as seed sowing depths, soil mixture ratios and fertilizer levels.

Materials and Methods
Seeds were sown in polybags in four different soil mixture ratios (sand: clay: FYM such as R_1 (1:1:1), R_2 (1:2:1), R_3 (2:2:1) and R_4 (1:2:2).

Sowing depth: Seeds were sown at four sowing depths, *viz*. D_1 (0.5cm), D_2 (1.0cm), D_3 (1.5cm) and D_4 (2.0cm) with 2:1:1 soil mixture ratios in polybags.

Nutritional treatments: Seeds were sown in polybags containing 2:1:1 soil mixture ratios Nine treatments (T_1 - T_9) were: control, biovita (biomanure, 20 kg ha^{-1}, 40 mg $polybag^{-1}$), compost (bio-fertilizer, 14 q ha^{-1}; 2.8 g $polybag^{-1}$); fertonic (bio-manure, 60 kg ha^{-1}; 120 mg $polybag^{-1}$); FYM (farmyard manure, 8 t ha^{-1}; 16 g $polybag^{-1}$); hexameal (organic manure, 40 q ha^{-1}; 8 g $polybag^{-1}$); neem cake (60 kg ha^{-1}; 120 mg $polybag^{-1}$) NPK (full dose, 60:40:30 kg ha^{-1}; 255:450:100 mg $polybag^{-1}$) and VAM (100 g $polybag^{-1}$; once only). For VAM treatment, soils were collected underneath the *Canchrus ciliaris* and *C. srtigerus* which have spores of Gloums genus.

Observation
It is evident from Table-1 that among different soil mixture ratios, 83.33% seedlings emerged in R_2 followed by 73.33% in R_2, 66.66% in R_4 and minimum 63.33% in R_1.
Among different sowing depths, maximum seeding emergence (83.33%) was observed in D_2 depth followed by 73.33% in D_1 and minimum 66.66% in D_4. The seedling emerged after 6 to 8 days of experimental setting.

Table 1: Effect of different treatments on seedling emergence in *P. harmala* under nursery conditions

Treatments	Seedling emergence	
	Days	Percent
Soil mixture ratio: (Sand: clay: FYM)		
R_1 (1:1:1)	6	63.31
R_2 (1:2:2)	4	83.31
R_3 (2:2:1)	4	73.31
R_4 (1:2:2)	5	66.66
CD	NS	9.673*
Sowing depths:		
D_1 (0.5 cm)	4	73.31
D_2 (1.0 cm)	4	83.33
D_3 (1.5 cm)	5	70.00
D_4 (2.0 cm)	6	66.64
CD	NS	7.443**

The data on percentage of seedling emergence were signification at 5 and 1% probability levels for soil mixture and sowing depth treatments, respectively.

Growth parameters

It is evident from Table 2 that maximum plant height (18.17 cm) and collar diameter (0.189 cm) were observed in R_2 soil mixture ratios, while minimum in R_1 for 120 days after treatments (DAT). Among sowing depth experiments, maximum plant height (29.66 cm) and collar diameter (0.138 cm) were recorded in D_1, while minimum in D_4.

The data were signification at 5 & 1% probability levels in both the treatment except for collar diameter 30 DAT, which was non-significant.

Biomass

Table-3 shows the data pertaining to the effect of different soil mixture ratios and sowing depths on plant biomass. The result reveal that maximum above (0.231 g plant^{-1} dry wt.) and belowground (0.110 g) biomass were observed in R_2 and minimum in R_1 treatment. In sowing depth experiments, the maximum above (0.244 g) and belowground (0.114 g) biomass were recorded in D_2 and minimum in D_4 treatment.

Table 2: Effect to different soil mixture ratios and sowing depth on growth parameters (cm) minimum

Treatments	Plant height (DAT)				Collar diameter (DAT)			
	30	60	90	120	30	60	90	120
Soil mixture ratios:								
R_1(1:1:1)	3.89	6.31	7.94	9.7	0.044	0.078	0.091	0.091
R_2(1:2:2)	6.15	11.98	15.59	18.17	0.051	0.101	0.126	0.139
R_3(2:2:1)	5.52	9.65	11.33	14.27	0.048	0.091	0.105	0.113
R_4(1:2:2)	4.15	8.56	9.66	10.98	0.045	0.084	0.097	0.104
CD	0.6572**	0.9282**	0.9747**	1.51**	0.0072**	0.0753**	0.0113**	0.0088**
Sowing depth:								
D_1 (0.5 cm)	4.86	11.86	21.97	29.64	0.049	0.101	0.126	0.136
D_2 (1.0 cm)	4.63	10.46	20.87	27.83	0.046	0.096	0.118	0.121
D_3 (1.5 cm)	3.66	8.52	16.66	20.85	0.044	0.087	0.094	0.103
D_4 (2.0 cm)	3.52	7.64	15.89	19.60	0.041	0.083	0.092	0.097
CD	0.3441**	0.6377**	1.1167**	1.335**	NS	0.011*	0.0134**	0.0155**

DAT = Days after treatments; NS = Non-significant and * & ** = Significant at P = 5 & 1% respectively

Table 3: Effect of different soil mixture ratio and sowing depth on above and belowground biomass (g plant^{-1} d. wt.) in *P. harmala*

Treatments	Above ground (DAT)				Below ground (DAT)			
	30	60	90	120	30	60	90	120
Soil mixture ratio								
R_1	0.0123	0.040	0.107	0.162	0.004	0.007	0.017	0.054
R_2	0.0184	0.087	0.171	0.231	0.008	0.012	0.031	0.110
R_3	0.0153	0.072	0.141	0.199	0.005	0.008	0.025	0.076
R_4	0.0124	0.057	0.123	0.184	0.005	0.008	0.021	0.062
CD	0.003**	0.0129**	0.0292**	0.0308**	0.0014**	0.003**	NS	0.0205**
Sowing depth								
D_1	0.029	0.098	0.156	0.199	0.007	0.009	0.033	0.089
D_2	0.034	0.120	0.216	0.244	0.008	0.011	0.055	0.114
D_3	0.023	0.060	0.133	0.173	0.006	0.007	0.027	0.068
D_4	0.025	0.055	0.127	0.156	0.004	0.005	0.024	0.045
CD	NS	0.022**	0.03**	0.021**	NS	0.0026**	0.0151**	0.0259**

DAT = Days after treatments; NS = Non-significant and ** = Significant at P = 1%

So, R_2 mixture ratio and D_2 depth were better than other soil mixture ratios and depth experiments. The data were significant at 1% probability level for both the treatment during different months except for belowground biomass 90 DAT in soil mixture ratio and above & belowground biomass 30 DAT in sowing depth experiments, which were non-significant.

Nutritional treatments

(a) Growth parameters: The maximum percentage increase in plant height was observed in NPK (610.00) treated plants following by biovita (523.82), compost (504.79) and minimum (350.63) in control 120 DAT. The collar diameter showed maximum percentage increase in biovita (542.50) followed by compost (531.81) and minimum in control (321.73) experiments (Table 4)

(b) Biomass: A perusal of the data Table 5 reveals that the maximum percentage increase in aboveground and belowground biomass were recorded in NPK followed by biovita and minimum in control 120 DAT.

The data obtained for all parameters in both treatments were highly significant at 1% probability level (Table 4 & 5).

Table 4: Effect of various nutritional treatments on plant height and collar diameter in *P. harmala*

Treatments	BT	Plant height (cm) AT (DAT)				% increase 120 DAT over	BT	Collar diameter (cm) AT (DAT)				% increase 120 DAT over BT
		30	60	90	120			30	60	90	120	
T_1 (control)	5.51	9.78	15.62	20.15	24.83	350.63	0.046	0.117	0.133	0.167	0.194	321.73
T_2 (biovita)	5.12	15.01	24.83	30.72	31.94	523.82	0.040	0.149	0.215	0.247	0.257	542.50
T_3 (compost)	5.42	14.77	23.79	29.95	32.78	504.79	0.044	0.164	0.233	0.262	0.278	531.81
T_4 (fertonic)	5.56	13.06	21.84	23.93	26.99	385.43	0.045	0.135	0.177	0.185	0.217	382.22
T_5 (FYM)	5.52	14.27	22.87	26.55	29.95	442.57	0.051	0.124	0.192	0.238	0.247	384.31
T_6 (hexameal)	5.80	12.64	19.42	23.76	25.15	333.62	0.044	0.119	0.172	0.191	0.214	386.36
T_7 (neem cake)	5.60	13.77	20.15	22.97	26.34	370.35	0.046	0.129	0.180	0.189	0.199	332.60
T_8 (NPK)	5.10	16.31	26.64	34.88	36.21	610.00	0.044	0.141	0.186	0.209	0.211	379.00
T_9 (VAM)	5.91	12.83	20.75	25.15	28.14	376.94	0.050	0.128	0.201	0.226	0.231	362.00
	NS	0.7446**	1.134**	1.474**	1.82**		NS	0.001**	0.001**	0.0145**	0.0019**	

DAT = Days after treatments; BT = before treatment; AT = After Treatment; NS = Non-significant and ** = Significant at P = 1%

Table 5: Effect of various nutritional treatment on above belowground biomass (g plant^{-1} d. wt.) in *P. harmala*

Treatments	BT		AT (DAT)								% increase 120 DAT over BT	
			30		60		90		120			
	Above ground	Below ground	Above ground	Below ground	Above ground	Below ground	Above ground	Below ground	Above ground	Below ground	Above ground	Below ground
T_1	0.053	0.008	0.091	0.015	0.119	0.049	0.584	0.165	0.618	0.212	1066.03	2550.00
T_2	0.052	0.006	0.215	0.022	0.972	0.163	3.523	0.544	3.649	0.592	6917.30	9766.66
T_3	0.050	0.009	0.184	0.019	0.683	0199	3.127	0.580	3.250	0.647	6400.00	7088.88
T_4	0.052	0.007	0.131	0.015	0.445	0.093	1.567	0.266	1.618	0.327	3011.53	4571.42
T_5	0.051	0.009	0.172	0.015	0.580	0.196	2.975	0.658	3.063	0.692	5905.88	7588.88
T_6	0.052	0.008	0.155	0.015	0.528	0.119	2.745	0.330	2.815	0.395	5313.46	4837.50
T_7	0.052	0.007	0.144	0.020	0.503	0.147	2.618	0.464	2.745	0.543	5178.84	7657.14
T_8	0.050	0.006	0.256	0.039	1.082	0.236	4.196	0.755	4.287	0.806	8474.00	13333.33
T_9	0.051	0.008	0.137	0.016	0.473	0.102	1.614	0.310	1.702	0.370	3237.25	4525.00
CD	NS	NS	0.023**	0.0130**	0.032**	0.0204**	0.0043**	0.041**	0.0065**	0.042**		

DAT = Days after treatments; BT = before treatment; AT = after treatment; NS = Non-significant and ** = significant at P = 1%

Discussion

A suitable growing medium provides anchorage, nutrients and moisture for growing seedling (Landis *et al*., 1990) [6]. Growing medium in a polybag is light, easy to handle, maintains constant volume when wet or dry and can be readly stored for longer durations without any change in its physical and chemical properties. Sand and soil (1:1) mixture is most commonly used as germinating medium because both are readly available (Liegal and Venator 1987) [7]. Saharan *et al*., (2002) observed maximum germination and batter growth performance in 1:2:1 soil mixture ratio of sand: clay: FYM: FYM at 0.5 to 1.0 cm depth in Commiphora weight. Chauhan and Nautiyal (2007) [9] reported that 1:1:1 soil mixture ratio (soil: sand: FYM) at 0.5 cm sowing depth were favourable for obtaining maximum seed germination in Nardostachay Jatamansi. In the persent studies, 1:2:1 soil mixture ratio and 1.0 cm sowing depth were suitable to obtain the optimum growth and biomass in *P. harmala*.

Conclusion

Among the mineral nutrients, N, P and K are required in comparatively larger quantities and thus influence plant growth more than any other nutrient. These essential elements though found naturally in soils, sometimes get depleted and become a limiting factor for plant growth. Considering the importance of nutrient, particularly N, P and K, it is essential to determine their optimum doses for ideal growth of plants (Varshnay *et al.*, 2001). Arun *et al*., (2004) [11].

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