

Influence of Planting Methods and Organic Manure Levels on Productivity and Soil Quality of Aloe Vera in Chhattisgarh Plains

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ABSTRACT

A field experiment carried out during *Kharif-rabi* season 2014-15. The treatments allotted to main plots were flat bed planting, ridge and furrow planting and raised bed planting and the treatments allotted to sub plots were vermicompost @ 2.5 t ha⁻¹, vermicompost @ 5 t ha⁻¹, FYM @ 5 t ha⁻¹ and FYM @ 10 t ha⁻¹. The experiment was laid out in split plot design with three replications. Results revealed that the raised bed planting and application of vermicompost @ 5 t ha⁻¹ significantly highest herbage yield of aloe vera was recorded and available nitrogen and phosphorus was significantly highest found with application of vermicompost @ 5 t ha⁻¹. Interaction between treatments, significantly highest herbage yield of aloe vera was recorded under raised bed planting and application of vermicompost @ 5 t ha⁻¹ at same level of application of vermicompost @ 5 t ha⁻¹ and raised bed planting, respectively.

Key words *planting methods, organic manure levels, soil quality and aloe vera.*

Aloe vera (*Aloe barbadensis* Mill.) is an important medicinal plant cultivated for the clear leaf gel (contains glucomannans, amino acids, lipids, sterols and vitamins) and latex or leaf exudates. The latex is pale yellowish liquid which oozes out from the leaf lining or epidermal layer when cut. Active principles present in the leaf exudates of *A. barbadensis* are mainly barbaloin (aloin A) (1, 8-Dihydroxy-10-(β -D-glucopyranosyl)-3-(hydroxymethyl)-9(10H)-anthracenone) and its diastereoisomer, isobarbaloin (aloin B) (Gutterman and Chauser-Volfson 2000). Aloe leaf exudate is used as a laxative drug due to its cathartic action and as a bittering agent in alcoholic beverages (Gutterman and Chauser Volfson, 2008). It is also used against indications as seizures, asthma, colds, ulcers, bleeding, amenorrhea, colitis, depression, diabetes, glaucoma, multiple sclerosis, hemorrhoids,

peptic ulcers, varicose veins, bursitis, arthritis and vision problems (Eshun and He, 2004). Planting method is considered an important aspect of advanced production technology which not only ensures better crop establishment but also results in water saving when the crop is sown on ridges or raised beds (Malik, *et al.*, 2003). Lack of adoption, right planting method and nutrient management of aloe vera crop are under real farm condition form a major factor for lower yield realization in the country. Organic manures are considered to be safe and yielding good produce by improving water penetration, water holding capacity, improvement in soil structure, microbial biomass, nutrient availability and drought and heat stress resistance. The beneficial effect of organic manures on growth and yield of crops could be attributed to the fact that after proper decomposition and mineralization, the manures supply nutrients directly to the plants and also have solubilizing effect on fixed forms of nutrients in soil (Sinha, *et al.*, 1981). It also helps in improving the soil pH which has an impact on plant growth. Nutrient management in aloe vera field may be one of the strategies for increasing of the yield of aloe vera. In this background information, the field experiment was conducted to study effect of planting methods and organic manure levels on soil quality and productivity of aloe vera under Chhattisgarh plains.

MATERIAL AND METHODS

Field experimental was carried out during *kharif-rabi* season of 2014-15 at the Instructional farm, Indira Gandhi Krishi Vishwavidyalaya, Raipur, (C.G.). The soil of experimental field was clayey in texture, locally known as "Kanhar" (*vertisols*). The soil was neutral in pH and medium in available nitrogen and available phosphorus and high in available potassium content. The experiment was laid out in split plot design with three replications. The treatments allotted to main plots were flat bed planting, ridge and furrow planting and raised bed

Table 1. Nutrient content in soil and herbage yield of aloe vera as influenced by planting methods and organic manure levels

Treatment	Herbage yield (t ha ⁻¹)	Carbon (kg ha ⁻¹)	Nitrogen (kg ha ⁻¹)	Phosphorus (kg ha ⁻¹)	Potassium (kg ha ⁻¹)
Main plot : Planting methods					
M ₁ : Flat bed planting	18.02	0.46	226.10	18.07	376.04
M ₂ : Ridge and furrow planting	19.28	0.51	240.51	19.19	358.40
M ₃ : Raised bed planting	21.11	0.52	252.13	19.89	381.64
SEm ±	0.59	0.02	5.28	0.79	16.12
CD (P=0.05)	2.33	NS	NS	NS	NS
Sub plot : Organic manure levels					
S ₁ : FYM @ 5.0 t ha ⁻¹	17.92	0.48	228.28	17.86	365.86
S ₂ : FYM @ 10.0 t ha ⁻¹	19.33	0.52	234.97	18.54	378.56
S ₃ : Vermicompost @ 2.5 t ha ⁻¹	19.43	0.47	232.05	19.71	369.22
S ₄ : Vermicompost @ 5.0 t ha ⁻¹	21.20	0.50	263.01	20.10	374.45
SEm ±	0.39	0.01	3.60	0.54	11.26
CD (P=0.05)	1.16	NS	10.79	1.63	NS
Interaction	S	NS	NS	NS	NS

planting and the treatments allotted to sub plots were vermicompost @ 2.5 t ha⁻¹, vermicompost @ 5 t ha⁻¹, FYM @ 5 t ha⁻¹ and FYM @ 10 t ha⁻¹. Organic manures and vermicompost were incorporated at the final stage of field preparation as per the treatment details. In order to evaluate the initial fertility status and after harvest to know about soil properties of the experimental plot, soil samples (0-15 cm depth) were randomly taken with the help of soil auger to make a composite sample. Walkley and Black's method (Jackson, 1967), Alkaline permanganate method (Subbiah and Asija, 1956), Olsen's method (Olsen *et al.*, 1954) and Flame photometric method (Jackson, 1967) for the determination of organic carbon, available nitrogen (N), phosphorus (P) and potassium (K), respectively. Statistical analysis as per the procedure laid down by Gomez and Gomez (1984). The significance of treatment effects was tested with variance ratio (f-value). Appropriate standard errors and critical difference at 5% probability level to test the statistical significance of the results.

RESULTS AND DISCUSSION

Effect on herbage yield

The data on herbage yield of aloe vera as influenced by different treatments are presented in Table 1 and 2. The herbage yield was influenced significantly due to various planting methods. Among the planting methods, highest herbage yield

(21.11 t ha⁻¹) was produced with raised bed planting and it was at par with ridge and furrow planting method. The lowest herbage yield (18.02 t ha⁻¹) was recorded with flat bed planting. Different organic manure levels were influence significantly on herbage yield of crop. Among the different organic manure levels, maximum herbage yield (21.20 t ha⁻¹) was gave with application of vermicompost @ 5 t ha⁻¹ and it was followed by application of vermicompost @ 2.5 t ha⁻¹. The lowest herbage yield (17.92 t ha⁻¹) was recorded with application of farm yard manure @ 5 t ha⁻¹. The interaction effect between planting methods and organic manure levels were found significant. The raised bed planting was found statistically superior over all the treatment except ridge and furrow planting at same level of application of vermicompost @ 5 t ha⁻¹. The application of vermicompost was found statistically superior over FYM @ 5 t ha⁻¹, while it was at par with application of vermicompost @ 2.5 t ha⁻¹ and FYM @ 10 t ha⁻¹ at the same level of raised bed planting. Highest herbage yield was significantly affected by raised bed planting and vermicompost due to higher plant height, leaf length, no. of leaves and leaf thickness and fresh weight of leaves plant¹ to leads higher herbage yield. Chandra *et al.*, 2007 reported that the double row raised bed method was significantly higher the fresh root yield of safed musli as compared to the triple row raised bed method and ridge and furrow.

Table 2. Interaction effect of different planting methods and organic manure levels on herbage yield of aloe vera

Treatments	Herbage yield t ha ⁻¹				
	Organic manure levels				
Planting methods	FYM @ 5.0 t ha ⁻¹	FYM @ 10.0 t ha ⁻¹	Vermicompost @ 2.5 t ha ⁻¹	Vermicompost @ 5 t ha ⁻¹	Mean
Flat bed Planting	16.30	18.70	17.13	19.96	18.02
Ridge and furrow Planting	18.96	17.80	19.40	20.96	19.28
Raised bed Planting	18.50	21.50	21.76	22.70	21.11
Mean	18.92	19.33	17.92	21.21	
			SE±	CD (P=0.05)	
Planting methods			0.56	2.26	
Organic manure levels			0.36	1.09	
Sub plot at same level of main plots			1.12	2.23	
Main plot at same level of sub plots			0.78	2.27	

Effect on organic carbon

The data on organic carbon is presented in Table 1. The organic carbon was influenced not significantly due to various planting methods and different organic manure levels. Among various planting methods and organic manure levels, highest percent of organic carbon was found with raised bed planting and application of vermicompost @ 10.0 t ha⁻¹. Since the organic carbon in soil takes a long time to improve over initial hence even different organic manure levels options had no effect on the organic manure of the soil. However, the findings of Singh and Dubey, 2007 who reported that application of 80 kg N ha⁻¹ and addition of FYM @ 5 t ha⁻¹ improved the organic carbon (0.61%) content in soil.

Effect on available N

Available nitrogen in soil was influenced not significantly by various planting methods. However, highest available nitrogen in soil was found with the raised bed planting over flat bed planting (Table 1). In general the soil available nitrogen was increased significantly with increased dose of vermicompost. Among different organic manure levels, significantly the highest available nitrogen content in soil was recorded with application of vermicompost @ 5 t ha⁻¹ and it was followed by application of farm yard manure @ 10 t ha⁻¹. The lowest soil available nitrogen was recorded with application of farm yard manure @ 5 t ha⁻¹. Application of vermicompost increased available nitrogen content in soil after harvest of the crop

because of residual effect of applied vermicompost and improved the available nitrogen in soil. The findings of Umadevi *et al.*, 2010 who reported that application of 120 kg N ha⁻¹ significantly increased the N content in soil. Inoculation of oat seed with *Azotobacter* influenced N content in soil. Kumar *et al.*, 2015 reported that the highest available nutrients (available N 178.8 kg ha⁻¹) was recorded with 100% NPK + 12.5 tonnes FYM/ha.

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S: Significant, NS: Nonsignificant

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Effect on available P

Available phosphorus in soil was influenced not significantly due to various planting methods. However, highest available phosphorus in soil was obtained with the raised bed planting over the flat bed planting. Available phosphorus in soil was influenced significantly due to different organic manure levels. Among the different organic manure levels, significantly the highest available phosphorus content in soil was found with application of vermicompost @ 5 t ha⁻¹ over the application of FYM @ 5 t ha⁻¹, while it was at par with vermicompost @ 2.5 t ha⁻¹. The increased available P content of soil might be due to release of CO₂ and organic acids during decomposition, which helps in solubilizing the native soil P. The beneficial effect of FYM on available K status may be ascribed to the reduction in K-fixation due to the interaction of organic matter with clay besides the direct K addition to the K pool of the soil.

Effect on available K

Data presented in Table 4.17 reveals that various planting methods and organic manure levels were influenced non significantly on available K. However, raised bed planting and application of vermicompost @ 5.0 t ha⁻¹ were found highest potash in soils. The value of available K in soil ranges from 489.44-511.84 kg ha⁻¹. During decomposition of organic manures, various phenolic and aliphatic acids are produced which solubilize phosphatase and other phosphate bearing minerals and thereby lowers the phosphate fixation and increase its availability. Kumar *et al.*, 2015 reported that the highest available nutrients (available K 153.0 kg ha⁻¹) was recorded with 100% NPK + 12.5 tonnes FYM ha⁻¹.

The present study revealed that raised bed planting and application of vermicompost @ 5 t ha⁻¹ had significantly increased the herbage yield and all the soil parameters under aloe vera crop.

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