

Effect of Organic and Inorganic Sources of Fertilizers on Growth, Yield and Quality of *Bidi* Tobacco (*Nicotiana tabacum* L.) Variety GABT 11

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Authors' contributions

This work was carried out in collaboration among all authors. Author KMG planned the experiment and performed statistical analysis. Further author JPP carried out experiment in field for four years (2014-15 to 2017-18), wrote the first draft of manuscript and helped in statistical analysis. Author DHD carried out quality and chemical analysis in laboratory. Author GMP associated with this research project. All authors read and approved the final manuscript.

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ABSTRACT

A field experiment was conducted at Bidi Tobacco Research Station, Anand Agricultural University, Anand for four years from 2014-15 to 2017-18 with the objective to study the effect of organic and inorganic sources of fertilizers on growth, yield and quality of bidi tobacco variety GABT 11. Results revealed that different manures and fertilizers failed to exert their significant effect on yield of bidi tobacco variety GABT 11 during all four years and in its pooled. Green manuring every year with sunnhemp recorded significantly maximum leaf size viz. leaf length and width followed by application of FYM @ 12.5 t/ha every year. Besides, Application of 180 kg N/ha through ammonium sulphate gave significantly higher tobacco plant height over application of 180 kg N/ha through

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castor cake and application of 135 kg N/ha through ammonium sulphate + 90 kg P₂O₅/ha through single super phosphate + 135 kg K₂O/ha through sulphate of potash. Maximum monetary returns with benefit: cost ratio of 2.68 accrued with treatment of 180 kg N/ha through Ammonium sulphate. Among different bulky manures, green manuring with sunnhemp every year gave maximum gross income and net income with BCR value 2.43.

Keywords: Bulky manure; concentrated manure; green manure; fertilizer; tobacco yield.

1. INTRODUCTION

Bidi tobacco is grown in the middle Gujarat as mono crop for the last many years. Thus, the soil became poor in organic carbon and essential plant nutrients [1]. Moreover, nitrogen plays a key role in bidi tobacco production due to its effect on crop growth and its remarkable influence on quality of the bidi tobacco. Whereas, cured leaf from potassium deficient plants do not burn properly which warrants optimum potassium levels throughout the crop growth.

Total dependence on inorganic fertilizers could damage the physical properties of soil and impair soil health besides leading to nutrient imbalances in soil. Use of organic manures alone might not meet the plant requirement due to limited availability and presence of relatively low levels of nutrients. Perverse to detrimental effects of inorganic fertilizers, organic manures along with chemical fertilizers improve soil health resulting in enhanced crop yield [2]. Application of organic manure is essential for managing soil health, increasing yields (10-15%) and also imparts required flavor and taste to tobacco as per the consumer's preference [3]. Green manure is a good source of nitrogen and it increases the availability of phosphorus, potassium, secondary nutrients and trace elements in the soil [4]. Until now, the research was oriented to increase the yield through integrated use of organic and inorganic sources. Very little information is available on total use of organic manures for tobacco production. Keeping these in view, the present investigation was conducted to assess the influence of organic and inorganic sources of fertilizers on growth, yield and quality of bidi tobacco variety GABT 11 in middle Gujarat conditions.

2. MATERIALS AND METHODS

A field experiment was conducted at Bidi Tobacco Research Station, Anand Agricultural University, Anand (22.57° N, 72.93° E, 30 m asl) during 2014-15 to 2017-18. The experiment included twenty treatments in combinations of bulky manures and NPK fertilizers in a Split Plot

Design with three replications. Out of them four treatments of bulky manures [viz, No organic manure (N); Green manuring every year with sunnhemp (G); 12.5 tones FYM/ha every year (F₁) and 12.5 tones FYM/ha every alternate year (F₂) and five fertilizer combinations [viz, 180 kg N/ha through castor cake (C₄); 180 kg N/ha through ammonium sulphate (A₄); 90 kg N/ha through castor cake + 90 kg N/ha through ammonium sulphate (C₂A₂); 180 kg N/ha through AS + 90 kg P₂O₅/ha through SSP + 135 kg K₂O/ha through SOP (A₄P₂K₃); 135 kg N/ha through AS + 90 kg P₂O₅/ha through SSP + 135 kg K₂O/ha through SOP (A₃P₂K₃).

The soil of the experimental field is loamy sand with low available nitrogen, medium available phosphorus and high available potassium [5]. As basal dose, 100% recommended dose of FYM was applied one month before tobacco transplanting. Green manure crop sunnhemp was sown @ 100 kg/ha in the first week of June and incorporated in situ before flowering during 1st week of August. Among different fertilizer combinations, N, P₂O₅ and K₂O were applied from castor cake & ammonium sulphate, single super phosphate and sulphate of potash, respectively as per treatment as a basal dose before transplanting. The gross plot size was 13.5 x 4.5 m and net plot size was 11.7 x 2.7 m with spacing of 90 x 90 cm. Tobacco GABT 11 seedlings were planted in the first fortnight of September. The other recommended package of practices was followed in raising the crop. The leaf quality parameters (nicotine, reducing sugar, chloride, phosphorus and potash content) were analyzed as per standard analytical method. Nicotine, reducing sugar and chloride contents from tobacco cured leaves were determined by Harvey et al. (1969), Shaffer and Somogyi method modified by Heinze and Murneek (1940) and Murthy et al. (1962) methods, respectively. However, Phosphorus and potassium contents were determined by Vanadomolybdo phosphoric acid yellow color method, Jackson (1967) and Flame photometric method, Jackson (1967), respectively. Economics was computed based on the prevailing market prices of the inputs and tobacco cured leaf.

3. RESULTS AND DISCUSSION

3.1 Yield Attributes

The pooled results showed in Table 1 indicated that yield attributes of tobacco variety GABT 11 significantly affected with different bulky manures except plant height. Significant high values of leaf length and width were noticed under treatment G (Green manuring) as compared to treatments N (No organic matter) and F₂ (12.5 tones FYM/ha every alternate year). Similar results were also reported by Naik et al. [6] that the application of 120 kg N/ha as sunnhemp green manuring resulted in taller plants, larger leaf area, higher biomass production, green leaf and cured leaf yield. Whereas, different fertilizer combinations failed to exert their significant effect on yield attributes except plant height. Plant height was recorded significantly higher in treatment A₄ (180 kg N/ha ammonium sulphate) followed by treatments C₂A₂ and A₄P₂K₃ (180 kg N/ha through AS + 90 kg P₂O₅/ha through SSP + 135 kg K₂O/ha through SOP). Significant low plant height was noticed under treatment A₃P₂K₃ (135 kg N/ha through AS + 90 kg P₂O₅/ha through SSP + 135 kg K₂O/ha through SOP) which was remained at par with treatment C₄ (180 kg N/ha through castor cake). In case of value of root knot index (RKI), it was not significantly influenced either by bulky manures or fertilizer combinations.

3.2 Yield

Cured leaf yield of variety GABT 11 (Table 2) was not significantly influenced either by bulky manures or fertilizer combinations during individual years as well as pooled basis. However, the maximum cured leaf yield was noticed under treatments G (green manuring) and A₄ (180 kg N/ha through Ammonium sulphate) among different bulky manures and fertilizer combinations, respectively. Patil et al. [7] observed that incorporation of dhaincha as a green manuring crop in kharif season followed by growing potato in rabi season with 100% RDF found superior for recording maximum potato tuber yield. Patel et al. [8] who reported after Patil et al. [7] an increase in yield with ammonium sulphate over urea was 12.9%.

3.3 Quality Parameters

The quality parameters of cured leaf on pooled basis revealed that neither bulky manures nor fertilizer combinations significantly influenced nicotine, reducing sugar and chloride contents as well as phosphorus and potash contents of bidi tobacco cured leaf (Table 3). Similarly, chloride content of FCV tobacco was not significantly changed due to organic manures and nitrogen levels [9]. Patel et al. [10] reported that manures and different levels of nitrogen failed to exert

Table 1. Yield attributes of bidi tobacco variety GABT 11 as influenced by manures and fertilizer (Pooled over four years)

Treatments	Yield attributes (cm)			RKI (0-5) *	
	Leaf length	Leaf width	Plant height	$\sqrt{(x+1)}$	Original
A. Bulky manures					
N	56.2	24.0	76.9	1.572	1.58
G	59.5	27.7	80.0	1.686	1.99
F ₁	59.2	26.9	78.5	1.440	1.17
F ₂	58.3	26.1	79.8	1.518	1.42
S.Em. \pm	0.66	0.42	0.92	0.054	---
C.D.0.05	2.10	1.36	NS	NS	---
C.V. %	8.29	13.54	9.44	27.83	---
B. Fertilizer combinations					
C ₄	58.5	25.8	78.0	1.560	1.57
A ₄	58.1	26.3	80.4	1.569	1.58
C ₂ A ₂	58.1	26.1	78.7	1.544	1.50
A ₄ P ₂ K ₃	58.7	26.8	80.1	1.562	1.56
A ₃ P ₂ K ₃	58.0	25.8	76.6	1.536	1.50
S.Em. \pm	0.37	0.33	0.67	0.027	---
C.D.0.05	NS	NS	1.87	NS	---
C. V. %	4.35	8.67	5.87	12.12	---

*0=Free; 5=Maximum disease intensity

Table 2. Cured leaf yield of bidi tobacco variety GABT 11 as influenced by manures and fertilizers from 2014-15 to 2017-18 and pooled basis

Treatments	Yield (kg/ha)				
	2014-15	2015-16	2016-17	2017-18	Pooled
A. Bulky Manures					
N	4922	5288	5584	5821	5404
G	5295	5548	6958	6053	5964
F ₁	5137	5490	6510	6409	5886
F ₂	4491	5261	6828	6082	5665
S.Em. ±	212.1	183.7	339.1	204.3	166.4
C.D.0.05	NS	NS	NS	NS	NS
C.V. %	16.6	13.2	20.3	13.0	16.4
B. Fertilizer combinations					
C ₄	5088	5306	6311	6102	5702
A ₄	5208	5632	6303	5979	5781
C ₂ A ₂	4971	5255	6279	6152	5664
A ₄ P ₂ K ₃	4686	5350	6602	5906	5636
A ₃ P ₂ K ₃	4853	5441	6855	6317	5867
S.Em. ±	212.4	130.6	251.6	168.8	98.1
C.D.0.05	NS	NS	NS	NS	NS
C. V. %	14.8	8.4	13.5	9.6	11.9

Table 3. Chemical quality parameters as influenced by manures and fertilizers (Pooled over four years)

Treatments	Quality parameters (%)				
	Nicotine	Reducing sugar	Chloride	Phosphorus	Potash
A. Bulky manures					
N	5.1	3.9	0.92	1.14	0.78
G	5.5	3.7	0.92	1.24	0.78
F ₁	5.5	3.7	0.90	0.97	0.78
F ₂	5.4	3.7	0.94	1.06	0.78
S.Em. ±	0.21	0.08	0.05	0.12	0.00
C.D.0.05	NS	NS	NS	NS	NS
C.V. %	6.47	3.73	9.82	15.63	2.45
B. Fertilizer combinations					
C ₄	5.4	3.8	0.90	1.12	0.77
A ₄	5.4	3.8	0.94	1.11	0.77
C ₂ A ₂	5.6	3.8	0.91	1.14	0.78
A ₄ P ₂ K ₃	5.2	3.7	0.91	1.11	0.80
A ₃ P ₂ K ₃	5.3	3.7	0.93	1.06	0.80
S.Em. ±	0.1	0.1	0.02	0.04	0.01
C.D.0.05	NS	NS	NS	NS	NS
C. V. %	6.32	4.47	8.07	14.86	2.84

their significant effect on nicotine, reducing sugar and chloride contents.

3.4 Economics

The economic analysis indicated that, among different bulky manures, green manuring with sunnhemp every year gave maximum gross income Rs. 244215 and net income Rs. 143539 per hectare with BCR value 2.43. No

application of organic manure treatment gave maximum value of BCR as 2.56. In case of different fertilizer combinations, treatment A₄ (180 kg N/ha through Ammonium sulphate) gave maximum benefits with higher net returns (Rs. 148476/ha) and higher BCR value 2.68. The higher net returns from sunnhemp in situ green manuring was mainly due to higher cured leaf yield [11].

Table 4. Economics as influenced by manures and fertilizers on bidi tobacco GABT 11 (Pooled over four years)

Treatment	Yield (kg/ha)	Gross income (Rs./ha)	Common cost (Rs./ha)	Treatment cost (Rs./ha)	Total cost (Rs./ha)	Net income (Rs./ha)	BCR
1	2	3	4	5	6	7	8
A. Bulky Manures							
N	5404	221274	63468	23056	86524	134750	2.56
G	5964	244215	63468	37209	100677	143539	2.43
F ₁	5886	241049	63468	43902	107370	133679	2.25
F ₂	5665	232000	63468	33479	96947	135053	2.39
S.Em. ±	166.4	---	---	---	---	---	---
C.D.0.05	NS	---	---	---	---	---	---
C.V. %	16.4	---	---	---	---	---	---
B. Fertilizer combinations							
C ₄	5702	233481	63468	46707	110174	123307	2.12
A ₄	5781	236713	63468	24770	88237	148476	2.68
C ₂ A ₂	5664	231940	63468	35738	99206	132734	2.34
A ₄ P ₂ K ₃	5636	230803	63468	34099	97566	133236	2.37
A ₃ P ₂ K ₃	5867	240235	63468	30745	94213	146022	2.55
S.Em. ±	98.1	---	---	---	---	---	---
C.D.0.05	NS	---	---	---	---	---	---
C.V. %	11.9	---	---	---	---	---	---

Note: Selling price of Tobacco Rs./kg: Y₁ = 37.55, Y₂ = 40.51, Y₃ = 40.11, Y₄ = 40.95, average = 39.78

4. CONCLUSION

The study concluded that Ammonium sulphate @ 180 kg N/ha as well as green manure as bulky manure gave maximum net returns with benefit: cost ratio of 2.68 and 2.43, respectively. In addition, different manures and fertilizers failed to exert their significant effect on tobacco cured leaf yield and quality parameters (viz, nicotine, reducing sugar and chloride contents as well as phosphorus and potash contents) of bidi tobacco variety GABT 11 in pooled.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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