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# RESPONSE OF *BIDI* TOBACCO (*Nicotiana tabacum L.*) TO PLANTING METHODS AND PLANTING GEOMETRY UNDER RAINFED CONDITIONS IN VERTISOLS OF ANDHRA PRADESH

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**A field experiment was undertaken at Regional Agriculture Research Station, Nandyal, Andhra Pradesh from 2014-15 to 2017-18 on vertisols under rainfed condition to find out the response of bidi tobacco (*Nicotiana tabacum* L.) to suitable method of planting and planting geometry for higher cured leaf yield. The treatments consisted of two planting methods (Ridge method and flat bed method) and four planting geometry (60 cm x 50 cm, 60 cm x 75 cm, 75 cm x 50 cm and 75 cm x 75 cm) in factorial randomized block design and replicated thrice. The bidi tobacco variety used for experimentation was Nandyal Pogaku-1. Pooled analysis of the results indicated that ridge planting method recorded significantly higher leaf length (38.6 cm) and cured leaf yield (1657 kg ha$^{-1}$) against flat bed method planting (37.6 cm and 1417 kg ha$^{-1}$). Significantly higher cured leaf yield was recorded with planting geometry of 60 cm x 75 cm (1721 kg ha$^{-1}$) and was on par with 75 cm x 50 cm (1593 kg ha$^{-1}$). Higher leaf length (40.0 cm) and leaf width (16.2 cm) was observed at 75 cm x 75 cm planting geometry. Interaction effect of planting method with planting geometry found non significant. Higher net returns was observed in ridge method (Rs 87,785/ ha) with BCR of 2.96 whereas planting at 60 cm x 75 cm geometry recorded net returns of Rs 94,405/ha with BCR of 3.18.**

## INTRODUCTION

Tobacco (*Nicotiana tabacum* L.) is the most important non-food crop cultivated in more than 100 countries. It is one of the most important commercial crops of India, valued for its leaf containing nicotine. It is grown over an area of 0.46 million ha with production of 0.84 million tones with productivity of 1842 kg/ha (Agriculture statistics at a glance 2016 at www.agricoop.nic.in & http:// eands.dacnet.nic.in). In Andhra Pradesh, bidi tobacco is commercially cultivated under rainfed black soils in late rainy season i.e, September (2nd fortnight) month. The rainfed agriculture suffers from a number of hydro-physical and socio-economic constraints, which affect the productivity of rainy and post-rainy season crops. These include erratic and undependable rainfall, excess and deficient moisture within a season, harsh thermal regime, soil loss, low level of input use and technology adoption and resource poor farmers (Gupta, 2002). After few showers the monsoon rains in July – August and September are usually heavy and frequent. Under such situation water logging is a common problem which affects early growth, root proliferation and final yield performance of crop. Extreme variability in the quantity, time and duration of rains expose the soybean crop to soil moisture deficit as well as excess moisture either on account of delayed monsoon, longer dry spells or early withdrawal mansoon has been identified as one of the major factors for poor performance of soybean crops (Tiwari, 2014; Gupta *et. al.,* 2018). Studies on soil management for increasing crop production revealed that use of various tillage methods and modification of land configurations such as broad bed furrow, ridges and furrow for soybean in vertisols were superior over flat bed and recommended in watershed development for moisture conservation as well as for safe removal of excess rain water (Raut and Taware, 1997). There

**Key words:** Ridge planting, Planting geometry, Cured leaf yield, Economics, Leaf quality

is a need for in-situ soil and water conservation and proper drainage technology in black soils. This technology has many advantages including in-situ conservation of rainwater in furrows, better drainage of excess water and proper aeration in the ridge and root zone. Besides, other techniques the *In-situ* conservation of rainwater at farm level by adopting holistic approach to the management of rainwater like broad-bed and furrow, ridge and furrow, tied ridging, raised and sunken bed and compartmental bunding etc. by which crop productivity is substantially increased. Land treatments (raised sunken bed system, ridges and furrows, broad bed and furrows) increased *in situ* soil moisture conservation, minimized runoff, and soil erosion (Nagavallemma *et al.,* 2005). Hari Ram *et al.,* (2012) concluded that raised bed, raised broad bed and ridge furrow sowing of soybean should be advocated over flatbed sowing mainly due to their ability to save irrigation water. Plant spacing is required for the optimum yield. Closer spacing of plants resulted in reduction of size, body, thickness and weight per unit area of the leaf, Price of tobacco grown at higher plant densities was also lower, resulting in lower income from such production observed a decrease in total leaf area per plant with increased plant population Bukan *et al.*, (2010) Regulate the optimal density is one of the important factors to get the maximum yield due to the climatic conditions of each region and specifications of varieties are cultivated. Alizadeh *et al.*, (2013) studied the effect of plant spacing on tobacco yield of Burley variety. They observed that there is a negative relationship between plant spacing and yield. In view of the above fact the study was undertaken to find out the suitable method of planting as well as crop geometry to avoid water logging for higher cured leaf yield of bidi tobacco.

## MATERIALS AND METHODS

A field experiment was conducted at Regional Agriculture Research Station, Nandyal, Andhra Pradesh from 2014-15 to 2017-18 on vertisols under rainfed condition to find out the response of bidi tobacco (*Nicotiana tabacum* L.) to suitable method of planting and planting geometry for higher cured leaf yield. The soil of experimental site was medium deep black, moderately alkaline (pH-8.2), non saline (EC- 0.11 ds/m), low in nitrogen (152.3 kg $ha^{-1}$), medium in available $P_2O_5$ (32.5 kg $ha^{-1}$) and high in available $K_2O$ (350.9 kg $ha^{-1}$). The treatments consisted of two planting methods (Ridge method and flat bed method) as one factor and four planting geometry (60 cm x 50 cm, 60 cm x 75 cm, 75 cm x 50 cm and 75 cm x 75 cm) as another factor in factorial randomized block design and replicated thrice. The bidi tobacco variety used for experimentation is Nandyal Pogaku-1. Crop management practices like land preparation, N, P and K fertilizer application, weed control, intercultivation, need based plant protection, de suckering and sun curing were followed as recommended for local area. The data were recorded on soil moisture and quantitative traits such as plant height, leaf length, leaf width and cured leaf yield at harvest. Leaf quality parameters like nicotine and reducing sugars were analysed at CTRI, Rajahmundry. The mean values of all the quantitative characters were subjected to statistical analysis by adopting Fisher's method of analysis of variance as outlined by Gomez and Gomez (1984). The level of significance used in 'F' test was at 5 per cent.

## RESULTS AND DISCUSSION

### Soil moisture

Soil moisture was higher under ridge method (19.6%, 24.7%, 14.3% and 12.6% at 15 DAP, 30 DAP, 60 DAP and 90 DAP) when compared to flat method (17.6%, 21.2%, 12.1% and 10.6% at 15 DAP, 30 DAP, 60 DAP and 90 DAP) at all intervals except at 45 DAP during 2017-18 (Table 1). No significant change in soil moisture were observed among different plant geometry at different intervals. Comparatively higher moisture was recorded with plant geometry of 75 cm x 75 cm compared to 60 cm x 50 cm.

### Growth parameters and cured leaf yield

### Planting methods

Pooled data on growth parameters indicated that plant height did not differ significantly with planting methods (Table 2). Ridge planting method recorded significantly higher leaf length (38.6 cm) and cured leaf yield (1657 kg $ha^{-1}$) against flat bed method planting (37.6 cm and 1417 kg $ha^{-1}$).

Similar trend was observed in year wise data (Table 3). This may be attributed to fast draining of water and better aeration to the root system of crop planted on the ridge. Planting bidi tobacco under ridges and furrows method recorded significantly higher cured leaf yield than flat bed and broad bed and furrow methods of planting (Matiwade *et al.,* 2005). Jadav *et al.,* (2012) and Dhakad *et al.,* (2015) found higher growth parameters, yield and yield attributes parameters in ridge and furrow system over flat sowing system in soybean. Similar trends reported by Bhargav *et al.,* (2013). Ram *et al.,* (2011) also concluded that ridge and furrow sowing of soybean should be advocated over flatbed sowing mainly due to their ability to save irrigation water. Kumari and Rao (2005) reported that the crop growth rate and net assimilation rate were higher when crops are planted on ridge and furrow or bed planting system for mustard.

**Planting geometry**

Plant height did not differ with planting geometry (Table 2). Significantly higher cured leaf yield was recorded with planting geometry of 60 cm x 75 cm (1721 kg $ha^{-1}$) was on par with 75 cm x 50 cm (1593 kg $ha^{-1}$) . Similar trend was observed in year wise data (Table 3.). Higher leaf length (40.0 cm) and leaf width (16.2 cm) was observed at 75 x 75 cm planting geometry whereas lower leaf length (36.5 cm) and leaf width (14.6 cm) was recorded with plant geometry of 60 cm x 50 cm. Interaction effect of planting method with planting geometry found non significant. The increased yield at 60 cm x 75 cm could be attributed to optimum plant population and the genetic adoptability of tobacco crop to spatial arrangement. Similar results were reported by Kharazmi *et al.,* (2014) and Bukan *et al.,* (2010) in FCV tobacco, Kumaresan *et al.,* (2014) in chewing tobacco, and Arya *et al.,* (2011) in Jati tobacco and Patel *et al.,* (2011) in bidi tobacco.

**Interaction**

Higher cured leaf yield (1823 kg $ha^{-1}$) was recorded at plant geometry of 60 cm x 75 cm with ridge planting whereas lower cured leaf yield (1184 kg $ha^{-1}$) was recorded at plant geometry of 60 cm x 50 cm with flat planting (Table 4).

**Economics and Leaf quality parameters**

Higher net returns (Rs 87,785/ ha) with BCR of 2.96 was observed in ridge method and in planting at 60 cm x 75 cm spacing (Rs 94,405/ha and BCR of 3.18) (Table 5). Similar results reported by Bhargav *et al.,* (2013) and Dhakad *et al.,* (2015). They concluded that the higher gross as well as net monetary returns were recorded under ridge and furrow planting as compared conventional system. The chemical constituents of the leaf *viz.* nicotine and reducing sugars contents were not significantly altered either by the methods of planting or planting geometry and are in permissible limits. Similar results reported by Chavda *et al.,* (2011) and Patel *et al.,* (2011) in bidi tobacco. Bidi tobacco planting at plant geometry of 60 cm x 75 cm adopting ridge method of planting can be an optimum agronomic practice for higher moisture conservation, cured leaf yield, leaf quality and net returns in conditions of nandyal region of Andhra Pradesh.

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**Table 1: Effect of planting methods and planting geometry on soil moisture in *bidi* tobacco (2017-18)**

| Treatment | Soil moisture (%) | | | | |
|---|---|---|---|---|---|
| | 15 DAP | 30 DAP | 45 DAP | 60 DAP | 90 DAP |
| **Planting methods** | | | | | |
| Ridge method | 19.6 | 24.7 | 17.1 | 14.3 | 12.6 |
| Flat method | 17.6 | 21.2 | 15.7 | 12.1 | 10.6 |
| S.Em± | 0.43 | 0.67 | 0.61 | 0.40 | 0.43 |
| C.D.(P=0.05) | 1.3 | 2.0 | NS | 1.2 | 1.3 |
| **Planting geometry** | | | | | |
| 60cmx50cm | 18.1 | 22.3 | 15.9 | 12.8 | 11.4 |
| 60cmx75cm | 18.5 | 22.8 | 15.9 | 13.2 | 11.3 |
| 75cmx50cm | 18.4 | 23.1 | 16.8 | 13.3 | 11.3 |
| 75cmx75cm | 19.5 | 23.7 | 17.0 | 13.3 | 12.3 |
| S.Em± | 0.61 | 0.95 | 0.86 | 0.57 | 0.61 |
| C.D.(P=0.05) | NS | NS | NS | NS | NS |
| Interaction | NS | NS | NS | NS | NS |

**Table 2: Effect of planting methods and planting geometry on growth parameters, cured leaf yield, economics and leaf quality of *bidi* tobacco (Pooled data)**

| Treatments | Plant height (cm) | Leaf length (cm) | Leaf width (cm) | Cured leaf yield (kg/ha) |
|---|---|---|---|---|
| **Planting methods** | | | | |
| Ridge method | 71.1 | 38.6 | 15.5 | 1657 |
| Flat method | 68.1 | 37.6 | 15.5 | 1417 |
| SEm± | 1.5 | 0.2 | 0.1 | 43 |
| C.D.(P=0.05) | NS | 0.6 | NS | 131 |
| **Planting geometry** | | | | |
| 60cm x 50cm | 68.0 | 36.5 | 14.6 | 1320 |
| 60cm x 75cm | 70.1 | 38.7 | 15.9 | 1721 |
| 75cm x 50cm | 69.7 | 38.5 | 15.2 | 1593 |
| 75cm x 75cm | 72.5 | 40.0 | 16.2 | 1524 |
| SEm± | 3.0 | 1.0 | 0.5 | 62 |
| C.D.(P=0.05) | NS | 3.0 | 1.5 | 185 |
| Interaction | NS | NS | NS | NS |

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**Table 3: Effect of planting methods and planting geometry on cured leaf yield of *bidi* tobacco (year wise)**

| Treatments | 2014-15 | 2015-16 | 2016-17 | 2017-18 | Pooled |
|---|---|---|---|---|---|
| **Planting methods** | | | | | |
| Ridge method | 2266 | 1138 | 1673 | 1550 | 1657 |
| Flat method | 1840 | 1101 | 1366 | 1359 | 1417 |
| S.Em± | 22.7 | 19.5 | 43 | 26 | 43 |
| C.D.(P=0.05) | 69 | NS | 131 | 80 | 131 |
| **Planting geometry** | | | | | |
| 60cm x 50cm | 1850 | 934 | 1111 | 1383 | 1320 |
| 60cm x 75cm | 2211 | 1356 | 1795 | 1521 | 1721 |
| 75cm x 50cm | 2102 | 1184 | 1597 | 1490 | 1593 |
| 75cm x 75cm | 2050 | 1046 | 1577 | 1423 | 1524 |
| S.Em± | 32 | 28 | 61 | 35 | 62 |
| C.D.(P=0.05) | 98 | 84 | 185 | 105 | 185 |
| Interaction | NS | NS | NS | NS | NS |

**Table 4: Interaction effect of planting methods and planting geometry on cured leaf yield (kg/ha) of bidi tobacco (Pooled)**

| Treatments | 60cmx50cm | 60cmx75cm | 75cmx50cm | 75cmx75cm |
|---|---|---|---|---|
| **Ridge method** | 1452 | 1823 | 1677 | 1676 |
| **Flat method** | 1184 | 1614 | 1504 | 1367 |
| S.Em± | | | 87 | |
| C.D.(P=0.05) | | | NS | |

**Table 5: Effect of planting methods and planting geometry on economics and leaf quality of bidi tobacco (Pooled data)**

| Treatments | Net returns (Rs/ha) | BCR | Nicotine (%) | Reducing sugars (%) |
|---|---|---|---|---|
| **Planting methods** | | | | |
| Ridge method | 87785 | 2.96 | 4.97 | 2.26 |
| Flat method | 70585 | 2.65 | 4.69 | 2.24 |
| SEm± | | | 0.16 | 0.10 |
| C.D.(P=0.05) | | | NS | NS |
| **Planting geometry** | | | | |
| 60cm x 50cm | 61825 | 2.41 | 4.83 | 2.21 |
| 60cm x 75cm | 94405 | 3.18 | 4.86 | 2.23 |
| 75cm x 50cm | 83965 | 2.93 | 4.89 | 2.19 |
| 75cm x 75cm | 79145 | 2.85 | 4.82 | 2.46 |
| SEm± | | | 0.23 | 0.12 |
| C.D.(P=0.05) | | | NS | NS |
| Interaction | | | NS | NS |

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