Eco. Env. & Cons. 29 (January Suppl. Issue) : 2023; pp. (S136-S140)
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ISSN 0971–765X

DOI No.: http://doi.org/10.53550/EEC.2023.v29i01s.021

Agronomic Practices Enhancing the Productivity of Bidi Tobacco (*Nicotiana tabaccum* L.) – A Review

S. Jaffar Basha, J. Manjunath and P. Pullibai

Acharya N. G. Ranga Agricultural University, Lam, Guntur 522 034, Andhra Pradesh, India

(Received 2 May, 2022; Accepted 24 July, 2022)

ABSTRACT

Bidi tobacco is commercially cultivated under rainfed vertisols in late rainy season i.e., September (2nd fortnight). Six week old seedlings should be planted during August-September at planting geometry of 75 cm x 75 cm and ridge planting is advisable for higher moisture conservation. Standard bidi tobacco production requires 110 kg N, 70 kg P_2O_5 and 50 kg K_2O ha^{-1} which is closely dependent on mineral nutrient supply. Topping is done either at bud stage or early flowering stage by keeping 12–15 leaves. Bidi tobacco grown with two irrigations each at 5 cm depth / 0.4 IW/ CPE (first at 60 days after transplanting and second between 35-45 days after first irrigation) increased the yield which resulted from more leaf width. Foliar application of 2.5% KNO_3 or 2.5% AS + SOP twice at 45 and 60 DAT to bidi tobacco is optimum for supply of nitrogen and potassium under moisture deficit condition. Application of foliar spray with Triacontanol 0.1% EW @ 2ml /l at early growth stage and grand growth stage is economical during drought period. Bidi tobacco recorded higher seed yield (532 kg ha^{-1}) and oil yield (173.4 kg ha^{-1}) when planted at 60 cm x 60 cm with application of 150 % RDF (165 N+105 P_20_5+75 K_2O ha^{-1}).

Key words: *Bidi tobacco, Cured leaf yield, Irrigation, Nutrient management, Planting geometry, Seed oil, Topping.*

Introduction

Bidi 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^{-1}. The package of production technology for bidi tobacco crop involves growing of improved varieties, key agronomic operations including application of optimum dose of nitrogen and topping at proper leaf stage. Land configurations such as broad bed furrow, ridges and furrow 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. Optimum tobacco growth can only be achieved with adequate and well timed nutrient supply under favorable environments.

Planting time and planting method

Bidi tobacco is commercially cultivated under rainfed vertisols in late rainy season i.e., September (2nd fortnight). Six week old seedlings should be planted during August-September at planting geometry of 75 cm x 75 cm. Bukan *et al.* (2010) reported 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. Alizadeh *et al.*, (2013) studied the effect of plant spacing on tobacco yield of Barley variety. They observed that there is a negative relationship between plant spac-

ing and yield. Bidi tobacco planting at plant geometry of 60 x 75 cm under ridge planting is optimum for higher moisture conservation, cured leaf yield, leaf quality and net returns (Basha *et al.,* 2019[b]).

Fertilizer Management

The *bidi* tobacco (*Nicotiana tabacum* L.) plant requires large quantities of primary nutrients such as nitrogen (N), phosphorous (P), and potassium (K) in order to attain high leaf yield and good quality. Soil depletion of macronutrients is plausible because of the large input requirement to the tobacco crop (Hoyos *et al.,* 2015). Standard bidi tobacco production requires 110 kg N, 70 kg P_2O_5 and 50 kg K_2O ha^{-1} which is closely dependent on mineral nutrient supply. Half of nitrogen and total P and K should be applied basal. Remaining N should be applied at 30 DAS. Marowa *et al.* (2015) reported that there is still need to establish the nitrogen and priming levels which may vary with place and variety. The increase in yield and yield attributes due to increase in N level was reported by Basha *et al.* (2020[d]). Moula *et al.*(2018) reported a decline in soil macronutrients such as K, P, and S after tobacco cultivation. The release of nicotine into the rhizosphere was considered to have a major impact on the increase or decrease of these nutrients. Thus, nicotine ($C_{10}H_{14}N_2$) released in the soil could be mineralized and increase N in the soils, however, since nicotine is acidic, when mineralized could also influence solubilization of P and K to be readily available to the plant and reduce their levels in the soil. The nutrient P is essential for hastening tobacco root development as well as improvement of the color and quality of leaves. However, Vann *et al.* (2013) indicated that the residual soil K and soil texture make it challenging to establish the actual amount of K to be supplied to optimize yields especially for the new cultivars bred as higher yielding. The application of 100% RDN (110 kg) +PK (70 kg P_2O_5+ 50 kg K_2O) ha^{-1}once in two years or 100% RDN (110 kg) +P (70 kg P_2O_5) ha^{-1} every year produced higher cured leaf yield and fetched higher net returns and improved soil fertility (Basha *et al.,* 2020[b]).

Weed management

After the seedling establishment, three tyned cultivator is worked at weekly interval until the leaves cover the row spacing. This operation not only checks the weed growth but also leads to the formation of soil mulch for soil moisture conservation. Bullock drawn implements are used for earthing up.

Topping and Desuckering

Topping (removal of the flowering head and young leaves) is an essential cultivating measure to maximize leaf production and encourage leaf-ripening for air-cured tobacco, which switches the plant from reproductive to vegetative phase (Guo *et al.* 2011; Czubacka *et al.* 2012). Topping is a turning point for nicotine formation and accumulation inside tobacco plant (Guo *et al.,* 2011). Topping is done at flower bud initiation leaving 16-20 leaves. Topping of tobacco not only increases the yield but also improves the quality of cured leaf (Krishna Reddy *et al.,* 2012). Bglar and Behghan (2014) reported that topping at optimum growth stage enhanced tobacco leaf quality in field. Leaf chemical parameters did not differ due to different levels of topping. It was concluded from the study that, taking into consideration of obtaining higher cured leaf yields coupled with better quality, *bidi* tobacco could be grown profitably by topping either at bud stage or early flowering stage by keeping 12–15 leaves even during period of moisture stress condition. Topping at lower number of leaves was not desirable for cured leaf yield and quality (Basha *et al.,* 2020[a]). Suckers should be removed at 5-6 days interval. Pendimethalin (1.5%), decanol (7%) and neem oil emulsion (35%) etc., can also be used for desuckering instead of manual desuckering.

Irrigation

Yields are generally expected to increase when irrigation is applied during periods of dry weather. Bidi tobacco grown in middle Gujarat agro-climatic zone with irrigation at 0.4 IW/ CPE ratio and two irrigations each at 5 cm depth, (first at 60 days after transplanting and second between 35-45 days after first irrigation) increased the yield which resulted from more leaf width and greater plant height. Besides irrigation, high yielding varieties need more nutrients, particularly nitrogen to exploit their full potential. Application of 110 kg N ha^{-1} is required for realizing optimum yield and net returns for bidi tobacco grown under vertisols of Andhra Pradesh under rainfed conditions. Application of two irrigations (30 mm each) at 25 and 55 days after planting could be optimum for getting higher cured leaf yield and good quality of bidi tobacco grown under rainfed vertisols of Andhra Pradesh (Basha *et al.,* 2015).

Foliar Nutrition

Foliar fertilization should be done under conditions of decreased nutrient availability in soil, dry topsoil and decreased root activity during the reproductive stage. However, the efficiency of foliar fertilization depends on nutrient mobility within a plant. Foliar application of potassium is more suitable, target oriented and economical technique for increasing the fertilizer use efficiency and grain yield over soil application (Farooqi *et al.,* 2012). Foliar application of 2.5% KNO_3 or 2.5% Ammonium Sulphate + Sulphate of Potash twice at 45 and 60 days after planting to bidi tobacco is optimum for cured leaf yield and net returns. Leaf quality parameters like nicotine and reducing sugars were slightly altered by foliar nutrition and observed within the acceptable range. Foliar spray can serve a useful purpose in bypassing the soil to ensure optimal supply of nutrients to plants under conditions where nutrients supply to plants became a limiting factor (Basha *et al.,* 2019[a]).

Drought mitigation measures

Drought stress affects tobacco growth at the rosette, vigorous growth, flowering, and maturing stages (Shang *et al.,* 2010). Thus, water deficit has become a severe threat to sustainable agriculture (Castroluna *et al.,* 2014). Tobacco is an important economic crop with the leaf representing the primary product, and its productivity is vulnerable to drought. Uneven and low rainfall, dry winds, and temperature dynamics are common factors that promote the development of drought conditions Drought stress play a notorious role in decreasing crops productivity because water shares 80–95% of the fresh biomass of any plant (Furuhashi *et al.,* 2016). This drastic reduction in fresh biomass is mainly due to the disruption of plant's photosynthetic capacity by limiting its physiological and biochemical attributes under the water deficit environment (Furuhashi *et al.,* 2016 and Gilani *et al.,* 2020). Application of foliar spray with Triacontanol 0.1% EW @ 2 ml /l at early growth stage and grand growth stage in bidi tobacco grown under rainfed conditions is economical in realization of optimum cured leaf yield and net returns during drought period (Basha *et al.,* 2022)

Seed and Oil yield

Alternative uses of bidi tobacco gained importance in recent times to sustain the crop for non-conventional and economically viable application in food and industries. The research on alternative uses of tobacco is the order of the day, leading to critical examination of potentials of tobacco as 'an oil seed crop'. Furthermore, the tobacco seed cake, which is an oil extraction by-product, turns out to be a suitable source of amino acids for animal feed formulations. Tobacco varieties can guarantee a good oil yield from 30 to 40 % of seed dry weight, which has been successfully tested as a biodiesel. It is used as raw material in coating industries, preparation of printing inks, dyes, production of soaps, shoe polish, varnishes, an alternative to diesel fuel and potential use in food and coating industries.

Tobacco seed oil has great promise as edible oil due to dietary effect of linoleic acid in lowering the serum cholesterol. Tobacco is an industrial crop traditionally used for cigarette and cigar manufacturing. However, applying cold pressing, 93 % of the seed oil can be recovered. The promising alternative uses of tobacco are seed oil having nutritive, pharmaceutical and industrial uses (Awolola *et al.,* 2010). The tobacco seed contains on an average of 35% oil and linoleic acid is the major fatty acid (66 – 76%) (Sivaraju *et al.,* 2011). In spite of being a promising non-food crop for bioenergy, the industrial use of tobacco oil has been hampered by the low seed productivity. Tobacco plants have also been genetically engineered to enhance their oil content in green tissues for potential biofuel production (Vanhercke *et al.,* 2014). Tobacco can really become a novel industrial crop providing renewable sources for both biofuel and biomass as well with a further optimization of the cultivation protocol to increase the oil yield and to use the by-products (Michelle *et al.,* 2016). A119 recorded higher seed yield (532 kg ha^{-1}) and oil yield (173.4 kg ha^{-1}) when planted at 60 cm x 60 cm with application of 150 % RDF (165 N+105 P_20_5+75 K_2O ha^{-1}) (Basha *et al.,* 2020[c]).

Harvesting and Curing

Mature leaves showing full spangle development are harvested priming wise and placed with their upper surface facing the ground for drying. Afterwards it is graded as Bhuka (pure lamina), Geran (lamina pieces and veins), Galia (sand leaves) and Lakada or Rago (midribs).

Conclusion

It is inferred that the suitable agronomic practices

could be beneficial to enhance the productivity of *bidi* tobacco under prevailing environmental conditions. The yield potentials of *bidi* tobacco may not be realized without improved management practices.

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