EFFECT OF SPACING AND NITROGEN LEVELS ON YIELD AND QUALITY OF BIDI TOBACCO VARIETIES UNDER RAINFED CONDITION

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ABSTRACT

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EFFECT OF SPACING AND NITROGEN LEVELS ON YIELD AND QUALITY OF BIDI TOBACCO VARIETIES UNDER RAINFED CONDITION

Name of student

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Field experiment was carried out on loamy sand soil of the BTRS (Bidi Tobacco Research Station) Gujarat Agricultural University, Anand Campus, Anand to study the " Effect of Spacing and Nitrogen Levels on Yield and Quality of Bidi Tobacco Varieties Under Rainfed Condition " during kharif, 1992.

Eighteen treatment combinations involving three levels each of spacing (75cm x 90cm, 75cm x 75cm and 75cm x 60cm) and nitrogen (100, 150 and 200 kg / ha) alongwith two varieties of bidi tobacco (A 119 and GT 7) were tested in a factorial randomised block design with three replications.

The results indicated that the spacing treatment S_3(75cm x 60cm) produced significantly higher cured leaf yield as well as green and dry stalk yields compared to S_1 (75cm x 90cm) and S_2 (75cm x 75cm) spacings. Similar trend was observed for growth score, but in case of leaf length, S_1 (75cm x 90cm) was found to be significantly superior to S_3 while S_2 and S_3 were at par. The plant stand differed significantly among all the spacings, wherein S_3 recorded highest plant stand followed by S_2 and S_1. Whereas plant height, number of leaves per plant, leaf width, stem girth and spangle score were not significantly influenced due to different spacings. The spacing treatments also failed to manifest significant effect on nicotine and total nitrogen contents of leaf lamina.

Increasing rate of nitrogen application increased the cured leaf yield significantly. Application of 150 (N_2) and 200 kg N/ha (N_3) produced significantly higher cured leaf yield than 100 kg N/ha (N_1), the former two levels were at par. In case of green and dry stalk yields, 200 kg N/ha (N_3) was found significantly superior to 100 (N_1) and 150 kg N/ha (N_2). All other characters viz., final plant stand, number of leaves per plant, leaf length and width, plant height and stem girth remained unaffected due to nitrogen application except growth and spangle scores which were significantly higher in N_3 than N_1, there being no

significant difference between N_3 and N_2. The total nitrogen and nicotine contents of leaf were not significantly modified by levels of nitrogen.

Significant differences were obtained in cured leaf yield as well as green and dry stalk yields due to varieties. The variety GT 7 gave significantly higher cured leaf yield (2265 kg/ha) than A 119 (1707 kg/ha). The green and dry stalk yields also exhibited the same trend. The yield attributes viz., number of leaves per plant, leaf length, stem girth and growth as well as spangle score also were significantly higher in GT 7 than A 119, while plant height and leaf width remained unaffected due to varieties. Both the varieties remained at par in respect of nicotine and total nitrogen contents of leaf.

The economics of different factors indicated that S_3(75cm x 60cm) recorded maximum net profit of Rs. 9527 per ha, followed by S_2 (Rs. 8037/ha) and S_1 (Rs. 7182/ha). Among different nitrogen levels, intermediate level of 150 kg N/ha ranked first by giving net profit of Rs. 8588/ha . Between varieties, GT 7 (V_2) realized higher net profit of Rs.10757/ha than that of A 119 (Rs. 5739/ha).

Among different treatment combinations, $S_3N_2V_2$ (75cm x 60cm spacing, 150 kg N/ha and GT 7) accrued the maximum net realization of Rs. 12701/ha with CBR of 1:2.30.

Based on one year findings it is concluded that under rainfed condition of middle Gujarat, variety GT 7 should be preferred over A 119, which should be planted at 75cm x 60cm spacing and fertilized with 150 kg N/ha to realize maximum economic benefit.

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CERTIFICATE

This is to certify that the thesis entitled "**Effect of Spacing and Nitrogen Levels on Yield and Quality of Bidi Tobacco Varieties Under Rainfed Condition**" submitted by **Shri Jagdishkumar Motibhai Patel** in partial fulfilment of the requirements for the degree of **Master of Science (Agriculture)** in **Agronomy** of the Gujarat Agricultural University is a record of bonafide research work carried out by him under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma or other similar title.

Place : Anand

Date : 4th June, 1994

(R. B. PATEL)
Major Advisor

DECLARATION

This is to declare that the whole of the research work reported here in the thesis for the partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (AGRICULTURE) IN AGRONOMY** by the undersigned is the results of investigation done by him under the direct guidance and supervision of Dr. R.B. Patel, Research Scientist, H.F. Project, I.D.C. Unit No. 7, Gujarat Agricultural University, Anand Campus, Anand and no part of the work has been submitted for and other degree so far.

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Place : **Anand**

Date : 4th June, 1994

(**J. M. PATEL**)

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INTRODUCTION

CHAPTER-I

INTRODUCTION

Tobacco has the pride place among the commercial crops grown in the country. Tobacco and tobacco products accrued Rs. 2358.53 crores through excise revenue, besides foreign exchange of Rs. 377.03 crores to the national exchequer in the year 1991-92 (Anon., 1993 a). Although it is hardly cultivated in 0.3 per cent of total cropped area in India, it provides employment to about 30 lakh people, while about seven lakh farmers are directly involved in its cultivation.

In India, tobacco is grown in an area of 4.177 lakh hectares with a total production of 544.8 million kg showing the productivity of 1304 kg/ha (Anon., 1993 a). The principal types of tobacco grown in India are cigarette, bidi, chewing, cigar, burley, lanka, natu, hookah, snuff etc. Among these, bidi tobacco accounts for highest area (30 per cent) and production (35 per cent) (Anon., 1991). The cultivation of bidi tobacco is mainly confined to Gujarat (Kheda, Vadodara and Panchmahals districts), parts of Maharashtra (Kolhapur and Sangli districts), Karnataka (Nipani area of Belgaum district) and Andhra Pradesh (Kurnool district) states. In Gujarat, it covers 109.6 thousand hectares, producing 192.9 million kg with the

productivity of 1760 kg/ha (Anon., 1993 a). Tobacco is principally a drought tolerant crop, but to increase the production and productivity, liberal supply of nutrients and water is must. However, wherever scanty rainfall is received and the water quality is inferior, farmers resort to rainfed crop. In Gujarat, the area under irrigated tobacco is 60-70 per cent, but traders always look for the quality tobacco from the rainfed area, which always fetches higher price than the irrigated tobacco. It has been conclusively proved that rainfed bidi tobacco crop is superior in quality than the irrigated tobacco (Anon., 1985).

With a view to improve yield potential of rainfed crop, efforts have been made to evolve drought tolerant varieties. Recently, a drought tolerant variety GT 7 is released by the Bidi Tobacco Research Station, Anand, during the year 1993, which gives about 40 per cent higher yield over existing varieties (A 119 and GT 4). It has more number of leaves as compared to present varieties (Lakshminarayana, 1993). The agronomic requirement is yet not worked out under rainfed condition for achieving higher yield potential.

Among agronomic practices, spacing and nutrients supply play a vital role in augmenting production potential of rainfed bidi tobacco. Several workers working with bidi

tobacco varieties viz., A 119, A 2, GT 4 and 543-41 have reported increase in yield of tobacco under closer spacing with very little loss of quality (Patel, 1971 and Anon., 1978 a). The soil of Gujarat is rich in potash and medium in phosphorus, therefore, nitrogen is the important factor of study among major nutrients. Experimental results showed that application of nitrogen @ 150 kg/ha is optimum under rainfed condition for bidi tobacco varieties viz., GT 4, 123-22 and 3-58-38 (Anon., 1982 b). Keeping above facts in view the present study was planned to find out the effect of varying levels of spacing and nitrogen on the yield and chemical composition of bidi tobacco variety GT 7 under rainfed condition. The most popular variety A 119 was taken as a check for comparison. The objectives of present study are as under :

1. To compare the performance of newly evolved variety GT 7 with A 119 under rainfed condition under various spacing and nitrogen levels.
2. To find out optimum level of spacing and nitrogen for bidi tobacco variety GT 7 under rainfed condition.
3. To find out the influence of spacing and nitrogen levels on chemical composition of leaf.
4. To work out the economics of both the varieties under different spacings and nitrogen levels.

REVIEW OF LITERATURE

CHAPTER-II

REVIEW OF LITERATURE

An attempt has been made to review literature concerning quantitative as well as qualitative changes and economic aspects of bidi tobacco varieties under different spacing and nitrogen levels. The work done on other types of tobacco like cigarette, cigar, burley, natu, chewing, hookah etc. is also reviewed to a limited extent.

The available literature has been arranged under following headings :

2.1 Effect of spacing

2.1.1 Cured leaf yield and yield attributes

2.1.2 Chemical composition

2.2 Effect of nitrogen

2.2.1 Cured leaf yield and yield attributes

2.2.2 Chemical composition

2.3 Varietal difference

2.3.1 Cured leaf yield and yield attributes

2.3.2 Chemical composition

2.4 Interaction effect of spacing x nitrogen on cured leaf yield, yield attributes and chemical composition

2.5 Interaction effect of spacing x variety on cured leaf yield, yield attributes and chemical composition

2.6 Interaction effect of nitrogen x variety on cured leaf yield , yield attributes and chemical composition

2.7 Interaction effect of spacing x nitrogen x variety on cured leaf yield , yield attributes and chemical composition

2.1 Effect of spacing

2.1.1 Cured leaf yield and yield attributes

Kadam et al. (1952) working with cv. Valmonnai on light brown to red soil of Cigar and Cherrot Tobacco Research Station, Vedasandur (Tamil Nadu) during 1948-49 to 1950-51 observed that closer spacings (75cm x 60cm and 75cm x 67.5cm) gave significantly higher yield of cured leaf over wider spacings (75cm x 77.5cm and 75cm x 90cm). Eventhough, wider spacings induced better growth and development of individual plant i.e. leaf size and thickness, the improvement was not sufficient to compensate the loss in yield due to less number of plants per hectare. Similar experiment in North Bihar with cv. NP-70 indicated that closer spacing of 90cm x 60cm recorded 31 per cent higher yield over wider spacing of 90cm x 90cm (Sajanani, 1957).

Patel et al. (1961), while working with wrapper and hookah tobaccos at Tobacco Research Station, Dinhata reported that though closer spacing (60cm x 45cm) tended to reduce leaf length, breadth and yield of individual plants, the yield per hectare was significantly higher (14 %) over wider spacing (60cm x 60cm) without any appreciable loss in quality of rustica tobacco.

Patel (1962) reported from an experiment conducted at CTRI, Rajahmundry, on flue-cured tobacco at two spacings that wider spacing of 120cm x 60cm was superior to narrower spacing of 82.5cm x 82.5cm from yield and quality view points, while Patel (1967) reported that in case of bidi tobacco closer spacing of 97.5cm x 67.5cm realized higher return of K-20 without deteriorating the leaf quality over wider spacings of 90cm x 90cm and 97.5cm x 75cm.

At BTRS, Anand the effect of spacing (90cm x 90cm, 90cm x 75cm and 90cm x 60cm) was studied in several experiments with different cultivars. During the year 1962-63 and 1963-64, A 2, A 23 and A 119 recorded significantly higher cured leaf yield and net realization at closer spacing of 90cm x 60cm over rest (Anon., 1971). Similar findings were also noted during the year 1968-69 and 1969-70 for K 20, selection 12, A 2, A 23 and A 119. However, spacing differences were non-significant for leaf length and leaf width (Patel, 1971). The experimental results (1975-76 to 1976-77) of trials conducted at BTRS, Anand showed that planting of A 2, GT 4 and 2-1 varieties at narrower spacing (75cm x 60cm) recorded significantly higher cured leaf yield over wider spacing (75cm x 75cm) (Anon., 1977). Further, superiority of closer spacing (90cm x 60cm) over wider spacing (90cm x 75cm) was observed for A 2, GT 4 and 543-41 varieties during 1975-76 to 1977-78 (Anon., 1978 a).

The performance of GT 4 was tested at BTRS, Anand involving three levels of spacing (60cm x 60cm, 60cm x 75cm and 60cm x 90cm). The results (1980-81 and 1981-82) did not reveal differential response of spacing on yield as well as other traits viz., leaf length, leaf width and plant height barring growth score (Anon., 1982 a). Similar experiment with GT 4, 123-22 and 3-58-58 also failed to show significant response with regard to yield and yield attributing characters except leaf length, which was highest at 60cm x 75cm spacing (Anon., 1982 b).

Subbian (1983) carried out an experiment on tobacco cv. Vazhaikkapal grown at three plant spacings (60, 75 and 90 cm) in row spaced at 75cm apart. He reported that closely spaced crop (75cm x 60cm) gave highest leaf yield.

The results (1982-83 to 1983-84) of a trial conducted at Nipani showed that wider spacings viz., 100 cm x 100 cm, 100cm x 75cm and 75cm x 75cm being at par among themselves, recorded significantly higher yield of bidi tobacco cultivars NPN 190, A 119 and PL 5 over narrower spacing (100cm x 50cm) (Anon., 1984 a), whereas, the results of field investigation carried out at BTRS, Anand, during 1981-82 to 1983-84 with bidi tobacco selection 206-17 and selection 34-30 comprising two levels of spacing (75cm x 60cm and 90cm x 60cm) indicated that though spacings did not

reveal significant differences in yield and yield attributing characters, narrower spacing recorded higher yield over wider spacing (Anon., 1984 b).

The results of an experiment conducted at Venkatarammanagudem (Andhra Pradesh) involving three varieties (Peddavittanum, II-426 and II-435) and three levels of spacing (60cm x 60cm, 80cm x 60cm and 100cm x 60cm) revealed significant variation in fresh leaf yield, cured leaf yield and plant height due to spacings. Narrower spacing of 60cm x 60cm ranked first in yield and plant height followed by 80cm x 60cm and 100cm x 60cm (Anon., 1984 c), while another experiment carried out at same location with variety Pyruvittanum during 1986-87 to 1988-89 showed that differential spacing viz., 60cm x 60cm (27,777 plants/ha), 60cm x 75cm (22,222 plants/ha) and 60cm x 90cm (18,518 plants/ha significantly influenced the cured leaf yield. The two closer spacings (60cm x 60cm and 60cm x 75cm) being at par recorded significantly higher cured leaf yield over wider spacing of 60cm x 90cm (Anon., 1989 b).

With a view to study the effect of spacing (90cm x 60cm and 60cm x 60cm) on bidi tobacco variety A 119, an experiment was conducted at BTRS, Anand during 1983 to 1986. The results indicated that variable effects of spacing were significant only for leaf length and leaf width.

The leaf development was better in 90cm x 60cm spacing than 60cm x 60cm. The cured leaf yield and plant height did not show significant influence due to levels of spacing (Anon., 1986 a).

Kim et al. (1987) working in Korea during 1982 to 1984 with different spacings (105cm x 30cm, 105cm x 35cm and 105cm x 42cm) observed that leaf area, leaf weight per plant and weight per unit leaf area of harvested leaf increased with increasing spacing from 105cm x 30cm to 105cm x 42cm, however, highest yield was recorded with intermediate spacing of 105cm x 35cm.

The effect of spacings (90cm x 60cm, 90cm x 75cm and 90cm x 90cm) was studied at BTRS, Anand for three years (1985-86 to 1987-88) with bidi tobacco var. GT 5 and it was observed that cured leaf yield and spangle score were not significantly affected due to variable spacings, however, intermediate spacing of 90cm x 75cm recorded highest cured leaf yield and net realization (Anon., 1989 a).

Patel et al. (1989 a), while working at BTRS, Anand, reported that A 119 and GT 5, planted at wider spacing (90cm x 60cm) showed significantly better leaf development i.e. leaf length and leaf width than narrower spacing (60cm x 60cm), however cured leaf yield was not significantly influenced by variable spacings.

Razak et al. (1989) observed that transplanting of Virginia tobacco var. FCV Special at 40cm spacing, increased plant height and leaf yield by 17.1 and 50.1 per cent, respectively, but stem diameter, leaf length, width, thickness and yield per plant decreased compared with transplanting at 80cm apart.

An experiment was conducted on bidi tobacco var. A 2 at Agricultural Research Station, Nipani, with four plant densities (10,000 plant/ha at a distance of 100cm x 100cm, 13,332 plant/ha at a distance of 100cm x 75cm, 17,776 plant/ha at a distance of 100cm x 50cm) by Bhat et al. (1991). They observed that a plant population of 17,776 per hectare gave the highest yield, which was 48 per cent more than 10,000 plant/ha and was on par with 13,332 plant/ha and 20,000 plant/ha.

2.1.2 Chemical composition

Patel (1967) reported a significant increase in total-N content with increase in the spacing, whereas, Patel (1971) reported no much increase in total-N content of bidi tobacco with increase in level of spacing from 90cm x 60cm to 90cm x 75cm and 90cm x 90cm.

While working at BTRS, Anand during 1971-72, Rangaswamy (1973) pointed out that the nicotine content of plants grown with wider spacings i.e. 90cm x 90cm and

90cm x 75cm was significantly higher than those grown with closer spacing i.e.90cm x 60cm. He also reported that the total-N content was also significantly increased by increasing the plant spacing from 90cm x 60cm to 90cm x 75cm and then levelled off.

An experiment was conducted at BTRS, Anand with bidi tobacco var. GT 4 with three spacings (60cm x 60cm, 60cm x 75cm and 60cm x 90cm) during 1980-81 to 1981-82. The results indicated that nicotine potential in bidi tobacco was not affected by different spacings (Anon., 1982 a). Another experiment conducted at the same location to study the effect of spacing (90cm x 60cm and 60cm x 60cm) on late planted bidi tobacco var. A 119 during 1983-84 to 1985-86. The results revealed that there were significant differences for nicotine content with variable spacings, while nitrogen, reducing sugar and chloride contents were not found to be affected by levels of spacing (Anon., 1986 a).

Tripathi et al. (1986) reported that nicotine, chloride and filling value of FCV tobacco did not vary to any marked extent due to variable spacings.

Patel et al. (1989 a) observed significantly higher nicotine content in bidi tobacco varieties (A 119 and GT 5) with wider spacing (90cm x 60cm) than narrower (60cm x 60cm) spacing.

2.2 Effect of nitrogen

2.2.1 Cured leaf yield and yield attributes

Krishnamoorthy et al. (1954) obtained economic response of manuring upto 180 kg N/ha under Gujarat conditions. Likewise, Patel (1956) reported progressive increase in length, width and size of leaves as well as cured leaf yield with increase in the quantity of applied nitrogen. Similar results were also reported by Patel (1960).

Ramkrishna Kurup and Tejwani (1960) stated that nitrogen was of out standing importance in its effect on the growth of cigar tobacco. It also affected considerably shape, size , yield and quality of leaf.

Patel and Patel (1962) found that there was no adverse effect on yield and quality of bidi tobacco, even when the crop was fertilized with 270 kg N/ha. Moreover, Markose and Patel (1977) noticed positive response of nitrogen upto 300 kg/ha applied in form of groundnut cake and ammonium sulphate in 1:3 proportion.

Application of 60 and 80 kg N/ha gave significantly higher cured and middle leaf yields of burley tobacco varieties over 40 kg N/ha under the monsoonic conditions prevailing in the agency area of East Godavari district (Anon., 1978 b).

While working with chewing tobacco at Tobacco Research Station, Pusa (Bihar) for three years (1968-69 to 1970-71), Singh et al. (1981) reported that increasing levels of nitrogen from 0 to 168 kg/ha for chewing tobacco enhanced the yield of both cured and first grade leaves significantly.

Link and Terrill (1982) carried out field trials on burley tobacco with 110, 170 and 225 kg N/ha and observed that with increase in nitrogen fertilizer there was increase in yield. But difference between 170 and 225 kg N/ha was not significant.

An experiment was conducted at BTRS, Anand to study the effect of spacing and nitrogen levels on new drought tolerant selections of bidi tobacco. The results revealed that the effect of nitrogen (150, 200 and 250 kg N/ha) on yield and other attributes was non-significant, indicating that 150 kg N/ha was optimum for bidi tobacco selections viz., GT 4, 123-22 and 3-58-38 under rainfed condition (Anon., 1982 b).

It was observed that application of nitrogen @ 200 kg/ha significantly increased the cured leaf yield over 150 kg N/ha, whereas the mode of split application had not significantly influenced the cured leaf yield of natu tobacco (Anon., 1984 c).

Rao et al. (1984) conducted experiment at Burley Tobacco Research Centre, Jaddangi (Andhra Pradesh) for three seasons to evaluate the performance of five cultivars of burley tobacco under three levels (40, 60 and 80 kg/ha) of nitrogen. They observed linear response to nitrogen application. Oweida et al. (1985) reported that Burley 37 grown with 0, 100, 150 and 200 kg as ammonium sulphate per feddan (1 Feddan = 0.42 ha) showed similar trend as shown above for cured leaf yield. Maximum yield was recorded at 200 kg/feddan.

Hayee and Malik (1986) reported that desi tobacco grown with 50 and 100 kg N/ha had pronounced effect at 100 kg N/ha which increased plant height, leaf area, leaf number/plant and cured leaf yield.

Jaisani et al. (1987) reported that improved bidi tobacco variety GT 4 grown under rainfed condition of Sanand (Gujarat) for gadaku purpose gave significantly higher yield with 100 kg N/ha as compared to 50 to 75 kg N/ha in the form of ammonium sulphate.

While working at BTRS, Anand during 1985-86, Patel (1987) reported that leaf length, width, plant height and spangle score of bidi tobacco cv. GT 5 were not significantly influenced by N levels, but higher level (270 kg/ha) of nitrogen gave significantly higher cured leaf yield than

that of lower level (180 kg N/ha). Similarly, Hadiyal (1989) working at same station observed that the effect of nitrogen on cured leaf yield was significant. The maximum cured leaf yield was obtained at 200 kg N/ha, which was significantly higher than 100 and 150 kg N/ha. The effect of nitrogen levels on leaf length, width, plant height and spangle score was not significant.

An experiment was conducted at BTRS, Anand on fertilizer requirement for late planted bidi cultivars. The results revealed that the effect of fertilizer (180 and 270 kg N/ha) levels yield and other attributes was not significant. It was observed that the recommended dose of 180 kg N/ha was optimum for bidi tobacco variety A 119 and GT 5 (Patel et al., 1989 a). Similar results were also noted at BTRS, Anand (Anon., 1989 a).

An experiment was conducted at Venkataramannagudem (Andhra Pradesh) on natu tobacco to study the influence of nitrogen (150, 200 and 250 kg/ha) levels on cured leaf yield. The results showed that 250 kg N/ha gave significantly higher green and cured leaf yields than 150 kg N/ha, but it was at par with 200 kg N/ha (Anon., 1988).

An experiment conducted in clay loam soil at Agricultural Research Station, Nipani from 1978-79 to 1980-81 to find out the response of five improved varieties of bidi

tobacco to three levels (90, 120 and 150 kg/ha) of nitrogen. From the results, Bhat et al. (1990) reported that nitrogen application @ 150 kg/ha was found to be optimum.

Patel (1991), while working at BTRS, Anand during 1990-91 reported significant effect of nitrogen on cured leaf yield and yield attributes (leaf length, width, plant height, number of leaves per plant, spangle and growth scores) of bidi tobacco. He further reported that with increasing levels of nitrogen upto 200 kg/ha significantly increased the cured leaf yield, the highest cured leaf yield was obtained under 250 kg N/ha but it was at par with 200 kg N/ha. However, both the levels of nitrogen showed their superiority over 150 kg N/ha. Similarly, Suthar (1992) working at the same station also observed significant response of nitrogen for cured leaf yield and leaf length but other attributes were not significantly altered, wherein he observed significantly highest cured leaf yield and leaf length with 200 kg N/ha. The plant height and spangle score did not reveal consistent trend.

From the trial conducted at BTRS, Anand from 1988 to 1992, it was observed that the differences in cured leaf yield due to levels of nitrogen (100, 150 and 200 kg/ha) were not significant. Therefore, it was concluded that 100 kg N/ha was optimum for the rainfed condition (Anon., 1992 b).

To generate information on nitrogen requirement and topping levels under rainfed condition an experiment was conducted on recently released bidi tobacco variety GT 7 at BTRS, Anand during 1992-93. The results revealed that levels of nitrogen (150, 180 and 210 kg N/ha) did not significantly influence cured leaf yield and its attributes except leaf length and width. Application of 210 kg N/ha being at par with 180 kg N/ha, gave higher leaf length and width than 150 kg N/ha (Anon., 1993 b).

2.2.2 Chemical composition

Gowaikar and Shah (1961) studied the effect of NPK manuring to bidi tobacco cv. K 49 at Lambhvel. The levels were 0, 90, 180 and 270 kg/ha, for each of the nutrients. They reported significant increase in N, P_2O_5, K_2O and nicotine and decrease in Cao, Mgo and Cl contents of leaf due to increased nitrogen application.

Sims and Atkinson (1971) reported that in burley tobacco the concentrations of nitrate-N, total-N and nicotine were increased significantly with higher rates of nitrogenous fertilizer than lower rate.

Ling (1975) carried out an experiment on flue cured tobacco cv. Vam Hicks with five levels of nitrogen (0, 25, 50, 75 and 100 kg/ha). He observed that increasing

rates of nitrogen increased the content of total nitrogen and total alkaloids.

Murthy et al. (1976) conducted field experiment on FCV tobacco cv. Virginia gold with three levels of nitrogen (20, 40 and 60 kg/ha). They observed that application of nitrogen above 20 kg/ha in black soils resulted in a thicker leaf with higher nitrogenous constituents and lower sugars and quality ratios.

Venkatachari (1976) reported that nitrogen fertilization to hookah tobacco increased nitrogen, sulphur, magnesium and nicotine contents of cured leaf and decreased potassium content and leaf burn.

Nitrogen application at reduced rate (100 kg N/ha) had significantly lowered nitrogen, nicotine, P and K contents as well as K/Ca ratio as compared to 200 kg N/ha in cv. GT 4 (Anon., 1979).

Singh et al. (1980) working at Tobacco Research Station, Dinhata (West Bengal) reported that an application of 150 kg N/ha in wet and humid season and 100 kg N/ha in dry season gave more desirable concentrations of all nitrogenous constituents and quality ratios than 200 kg N/ha in the leaf of cigar wrapper tobacco.

Link and Terrill (1982) studied the effect of nitrogen (110, 170 and 225 kg/ha) and potassium fertilization

on yield, quality and chemical composition of burley tobacco, wherein they found that higher rates of nitrogen increased nicotine and nitrogen contents, while P, Ca and Mg contents of cured leaves were not affected significantly.

Lamarre (1983) had undertaken an experiment on FCV tobacco cv. Delhi 34 for three years, wherein he observed that nitrogen application increased nicotine, total-N, total alkaloids and decreased reducing sugar contents.

Srivastava and Rao (1984) conducted an experiment on cigar wrapper tobacco with three levels of nitrogen (60, 120 and 180 kg/ha). They reported that lower nitrogen (60 kg/ha) application showed significantly lower percentage of nicotine, total nitrogen and protein-N as compared to higher level (180 kg N/ha).

Chang et al. (1984) sutdied the influence of different levels of nitrogen on the chemical composition of flue cured tobacco during 1982 and 1983. They observed that increasing nitrogen application decreased the leaf quality. Total nitrogen, alkaloids and non-volatile organic acids contents were elevated with increasing nitrogen application.

Oweida et al. (1985) observed that the nitrogen and nicotine contents of lower, middle and top leaves of

burley tobacco increased, P content decreased and K and Cl contents were not affected by increasing ammonium sulphate application.

Hayee and Malik (1986) conducted an experiment on desi tobacco. They observed that effect of nitrogen levels (50 and 100 kg/ha) on leaf quality was found to be non-significant.

Patel et al. (1989 b) reported that tobacco fertilized with 180 kg N/ha had significantly higher chloride content than 270 kg N/ha, other constituents were not affected significantly.

An experiment was carried out at BTRS, Anand with three levels of nitrogen (100 , 150 and 200 kg/ha) alongwith three levels of irrigations under middle Gujarat conditions on cv. GT 5. It was observed that nitrogen application at increasing rates showed significant increase in total-N, P and K as well as nicotine content of lamina. Maximum nicotine content (8.38 %) was observed at 200 kg N/ha, which was significantly higher than 100 and 150 kg N/ha (Hadiyal, 1989).

At BTRS, Anand an experiment was conducted on bidi tobacco with different levels of nitrogen (100, 150 and 200 kg/ha). Results showed that only nicotine content was significantly affected due to various levels of nitrogen,

wherein 200 kg N/ha recorded significantly higher nicotine than 100 kg and 150 kg N/ha (Anon., 1992 b). In an another experiment conducted at the same research station on cv. GT 5 with four nitrogen levels (180, 270, 360 and 450 kg/ha), it was observed that nitrogen levels showed significant differences for nicotine and reducing sugar contents, wherein nicotine content was significantly higher at 450 kg N/ha compared to other levels except 360 kg N/ha (Anon., 1990 b). Contrary to above the results of an another experiment conducted at same location at three levels of nitrogen (135, 180 and 225 kg/ha) did not reveal significant differences for nitrogen, nicotine, reducing sugar and chloride contents (Anon., 1990 c).

2.3 Varietal difference

2.3.1 Cured leaf yield and yield attributes

The differences in the cured leaf yield of varieties evolved at Anand (A 2, A 23 and A 119) and Nipani (S 20 and Kumkumadri) were compared at BTRS, Anand during 1970-71 and it was observed that A 2 gave highest yield, while kumkumadri gave lowest yield. From realization view point also A 2 ranked first due to highest yield as well as better leaf quality than other varieties (Anon., 1973).

At BTRS, Anand during 1980-81 and 1981-82, selection 3-58-38 having maximum leaf width and plant height significantly out yielded GT 4, which attained maximum leaf length and spangling (Anon., 1982 b). In another experiment at same station selection 34-30 recorded significantly higher cured leaf yield over selection 206-17 (Anon., 1984 b).

Bidi tobacco cultivars viz., A 2, A 23 and A 119 released in 1969 at BTRS, Anand yielded 30 per cent more than K 20. The variety GT 4 released in 1976 gave 15 per cent more yield than A 2 (Anon., 1986 b). These findings are in confirmity with yield increases of 25,20 and 26 per cent of A 2, A 23 and A 119, respectively over K 20 as reported by Patel (1971) at BTRS, Anand.

Jaisani et al. (1987) reported that variety GT 4, released during 1976 gave on an average 28.5 per cent higher cured leaf yield than Sanand local under rainfed condition of Sanand (Gujarat).

An experiment was carried out on fertilizer requirements of late planted bidi tobacco cultivars (GT 5 and A 119) at BTRS, Anand. The results revealed that variety GT 5 gave significantly higher cured leaf yield and leaf width than A 119 (Anon., 1987). Similar findings were also reported by Patel et al. (1989 a).

An experiment was carried out at BTRS, Anand during 1988-89 with bidi and chewing tobacco cultivars viz., Gandiu-6, K 49, K 20, A 3, A 23, A 2, A 119, GT 4, GT 5, A 145, GT 6 (Anand) and S 20 and Kumkumadri (Nipani). From the results it was noticed that yield differences were significant for varieties. The recently released variety GT 5 maintained its significant superiority over others (Anon., 1990 a).

Bhat et al. (1990) working at Nipani, reported that variety A 2 gave significantly higher yield of anagad tobacco than other varieties viz., S 20, NPN 68, NPV 190 and A 119.

Patel (1991) working at BTRS, Anand during 1990-91, pointed out that though GT 5 gave significantly higher leaf length, more number of leaves, growth score and cured leaf yield over A 119, later was significantly superior to GT 5 in leaf width.

Bidi tobacco variety GT 4 with better smoking quality, resistant to leaf burn and higher degree of drought tolerance gave 12 per cent more cured leaf yield over A 119 (Anon., 1992 a).

While working at BTRS, Anand during 1990-91, Parmar (1992) reported that among bidi tobacco cultivars viz., GT 5, A 119 and 103-9-101, GT 5 recorded significantly

highest yield which was about 7 and 35 per cent more than A 119 and 103-9-101, respectively.

To generate information on nitrogen requirements and topping levels for a rainfed bidi tobacco variety GT 7, an experiment was conducted at BTRS, Anand during 1992-93 under rainfed condition. The variety was compared with A 119, which is accepted by the farmers even under rainfed areas. The results revealed significant differences for cured leaf yield, growth score, spangle score and leaf length between varieties. The variety GT 7 gave significantly superior yield and higher values for growth and spangle scores than A 119 (Anon., 1993 b). Lakshminarayana (1993) also reported that recently released drought tolerant variety GT 7 gave 40 per cent more yield than the existing varieties (A 119 and GT 4).

2.3.2 Chemical composition

Rangaswamy (1973) reported that among different bidi tobacco cultivars viz., A 2, A 119, A 23 and K 20, the variety A 2 contained significantly higher nicotine than others. But varieties did not differ significantly for total nitrogen content.

Chakraborty et al. (1982) conducted a trial for screening different bidi cultivars viz., old lines (old lines (Gandiu 5, Keliu 49, Keliu 20, Anand 3, Anand 23

and Surti 20), modern cultivars (A 119, Anand 2 and GT 4) and high alkaloid line (Kumkumadri). From the analytical data, they observed that all modern cultivars viz., A 119, Anand 2 and GT 4 had relatively higher level of total-N and nicotine than the earlier varieties.

The results of an experiment conducted at BTRS, Anand revealed that chemical constituents viz., nitrogen and nicotine contents remained unaffected due to bidi tobacco varieties viz., selection 206-17 and selection 34-30 (Anon., 1984 b).

Jaisani (1987) reported that among different bidi tobacco varieties under cultivation GT 5 contained highest nicotine.

Patel et al. (1989 a) observed that A 119 had significantly higher reducing sugar than GT 5, but the nicotine and nitrogen contents were significantly higher in GT 5 than A 119. Similar findings were also reported by Patel (1991).

Parmar (1992) stated that among bidi tobacco varieties viz., GT 5, A 119 and 103-9-101, total nitrogen content was significantly higher in 103-9-101, however, significantly higher nicotine content was recorded by GT 5 over others.

2.4 Interaction effect of spacing x nitrogen on cured leaf yield, yield attributes and chemical composition

While working with various levels of nitrogen (0, 90 and 180 kg/ha) and spacings (90cm x 60cm, 90cm x 75cm and 90cm x 90cm) using bidi tobacco variety Keliu 49 at Anand, Krishnamoorthy et al. (1954) reported that the interaction effect of spacing and nitrogen was non-significant for yield and other attributes.

An experiment conducted at BTRS, Anand during 1980-81 to 1981-92 to study the effect of spacing (60cm x 60cm, 60cm x 75cm and 60cm x 90cm) and nitrogen levels (200, 300 and 400 kg/ha) on nicotine potential of bidi tobacco var. GT 4. The results indicated that interaction effect of spacing and nitrogen was found to be non-significant for cured leaf yield and nicotine content (Anon., 1982 a).

Bhat et al. (1991), while working at Agricultural Research Station, Nipani having clayey soil to find out yield performance of A 2 variety of bidi tobacco in response to spacings (100cm x 100cm, 100cm x 75cm, 75cm x 75cm and 100cm x 50cm) and fertilizer dose (0, 50, 100 and 150 kg each of NPK per hectare), reported that interaction effect of spacing and fertilizer dose was non-significant for cured leaf yield.

2.5 Interaction effect of spacing x variety on cured leaf yield, yield attributes and chemical composition

Panikar et al. (1969), while working on sandy loam alluvial soil of Dinhata (West Bengal) observed that interaction effect of spacings (60cm x 45cm, 90cm x 45cm and 90cm x 60cm) and varieties (Dixie shade and Sumatra) was significant for cured leaf yield of cigar wrapper tobacco. Higher yield was given by Dixie shade grown at a spacing of 90cm x 45cm over both the wider (90cm x 60cm) and closer (60cm x 45cm) spacings, whereas for Sumatra variety any increase over 60cm x 45cm spacing was harmful for total yield.

An experiment was conducted at BTRS, Anand from 1975-76 to 1977-78, consisting of three bidi tobacco selections (A 2, GT 4 and 543-41) and two spacings (90cm x 60cm and 90cm x 75cm). The results indicated that the interaction effect of spacings and variety was found to be non-significant for cured leaf yield and other attributes (Anon., 1978 a).

From the results (1981-82 to 1983-84) of an experiment conducted at Nipani on bidi tobacco varieties viz., NPN 190, A 119 and PL 5 comprising four levels of spacing viz., 100cm x 100cm, 100cm x 75cm, 75cm x 75cm and 100cm x 50cm, it was noticed that the interaction effect

of spacing and variety was significant for cured leaf yield. For PL 5, 100 cm x 100cm spacing was found to be optimum, while 75cm x 75cm plant spacing was found to be optimum for A 119 (Anon., 1984 a).

While working at BTRS, Anand during 1983-84 to 1986-87, Patel et al. (1989 a) observed that interaction effect of spacing (60cm x 60cm and 90cm x 60cm) and variety (A 119 and GT 5) was not significant for chemical constituents viz., nicotine, nitrogen and reducing sugar.

An experiment conducted at Nipani on deep black soil under rainfed condition during 1992 to study the response of two natu tobacco cultivars (Sancated (WAF) and Natu Special) to spacings (70cm x 70cm, 75cm x 75cm and 82.5cm x 82.5cm). Results indicated that significant interaction between varieties and spacing was seen. Variety Sancated (WAF) gave significantly more green and cured leaf yield at 82.5cm x 82.5cm spacing than others, while Natu Special recorded significantly higher yield at 75cm x 75cm and 82.5cm x 82.5cm spacings than 70cm x 70cm spacing (Anon., 1993 c).

2.6 Interaction effect of nitrogen x variety on cured leaf yield, yield attributes and chemical composition

An experiment was conducted at BTRS, Anand to find out proper time of planting and nitrogen requirement of bidi tobacco cultivars. The experiment consisting of five dates

of planting coupled with two levels of nitrogen (180 and 270 kg/ha) and two varieties (A 119 and GT 5) of bidi tobacco. The results revealed that the variety and nitrogen interaction was found to be non-significant for cured leaf yield and other attributes (Anon., 1986 a).

Patel et al. (1989 a) conducted an experiment to find out planting time, spacing, topping and nitrogen requirement of bidi tobacco varieties. The experiment consisting of five dates of planting coupled with two levels of nitrogen (180 kg and 270 kg N/ha) and two varieties (A 119 and GT 5). The results indicated that the interaction effect of nitrogen and variety was found to be non-significant for cured leaf yield, plant height, leaf length and leaf width, while it was significant for chloride and reducing sugar contents.

Bhat et al. (1990) conducted an experiment on clay loam soils of Agricultural Research Station, Nipani from 1978-79 to 1980-81 to find out the response of five improved varieties (S 20, NPN 68, NPV 190, A 119 and A 2) of bidi tobacco with the three levels of nitrogen (90,120 and 150 kg/ha). Results revealed that the interaction effect of nitrogen fertilization on the yield performance of different varieties was not significant during all the three years of study.

Patel (1991), while working at BTRS, Anand observed that interaction effect of nitrogen (150, 200 and 250 kg/ha) and varieties (A 119 and GT 5 of bidi tobacco and GC 1 and AR 26 of rustica tobacco) was found to be non-significant for cured leaf yield, yield attributes and chemical composition.

2.7 Interaction effect of spacing x nitrogen x variety on cured leaf yield, yield attributes and chemical composition

The field study was conducted at BTRS, Anand during 1980-81 to 1981-82 to study the effect of spacing (60cm x 60cm, 60cm x 75cm and 60cm x 90cm) and nitrogen levels (150, 200 and 250 kg N/ha) on new drought tolerant selections of bidi tobacco (GT 4, 123-22 and 3-58-38). The result indicated that interaction effect of spacing, nitrogen and variety was found to be non-significant for cured leaf yield and yield attributes (Anon., 1982 b).

MATERIALS & METHODS

CHAPTER-III

MATERIALS AND METHODS

The field experiment was conducted at Bidi Tobacco Research Station (BTRS), Gujarat Agricultural University, Anand Campus, Anand during kharif season of the year 1992 with a view to know the effect of varying levels of spacing and nitrogen on the yield and quality of bidi tobacco variety GT 7 and A 119 under rainfed condition. The materials used and experimental techniques adopted in the present investigation are presented in this chapter.

3.1 Experimental site

The experimental site was located at the Bidi Tobacco Research Station, Gujarat Agricultural University, Anand Campus, Anand.

3.2 Soil characteristics

The soil of the experimental field is sandy loam. It is alluvial in origin, deep, well drained and highly retentive of soil moisture. The depth of water table is more than ten metres. Composite soil sample drawn from 0-22.5 cm depth before fertilizer application was analysed to know the physico-chemical properties of the soil (Table 3.1). The soil is poor in organic carbon and nitrogen contents, medium in available phosphorus and rich in available potash.

Table 3.1 : Physico-chemical properties of the soil of the experimental plot

Sr. No.	Constituent			Method adopted	Author
1.	**Mechanical composition**			International Pipette Method	Piper (1966)
	i) Coarse sand	(%)	0.98		
	ii) Fine sand	(%)	79.9		
	iii) Silt	(%)	4.3		
	iv) Clay	(%)	9.5		
2.	pH (1:2.5 : Soil : water ratio)		7.4	Backman pH meter	Jackson (1973)
3.	Organic carbon	(%)	0.35	Walkley and Black Method	Jackson (1973)
4.	Total nitrogen	(%)	0.034	Kjeldahl's Method	Jackson (1973)
5.	Available phosphorus (kg P_2O_5/ha)		37.9	Olsen's Method	Jackson (1973)
6.	Available potash (kg K_2O/ha)		436.0	Flame Photometric Method	Jackson (1973)

3.3 Climatological data

The climate of the charotar tract of the middle Gujarat in which the Anand Campus of Gujarat Agricultural University is located is sub-tropical. Anand is situated on 22°- 25' North latitude and 72°- 55' East longitude. It is 45.11 metre above the mean sea level.

Summer is fairly dry and hot, while the winter is fairly cool and dry. The rainy season that commences in June and ends in September is warm with moderate humidity. The regular winter season starts by the end of the October and recedes by the end of February. The coldest moths of winter season are December and January. The summer season commences in the beginning of March and ends by the end of June. May is the hottest month of the year.

There was no unseasonal rainfall received during the crop season. Overall, climate was cold and dry and the season was normal during the course of investigation.

The infestation of tobacco leaf eating caterpillar and whitefly was observed during experimentation. Plant protection measures were taken by spraying appropriate insecticides. These insecticides also prevented the vector whitefly which spreads the leaf curl disease.

The standard weekwise mean data on meteorotolical parameters recorded at the College Farm Observatory at Anand Campus, Anand for the period of investigation (August 1992 to January 1993) are presented in Table 3.2.

Table 3.2 : Mean weekly weather parameters recorded at the Meteorological Observatory Anand, for the crop season kharif-rabi 1992-93

Month	Standard week	Temperature (^{o}C)		Relative humidity (%)		Sun shine hours	Rainfall (mm)
		Maximum	Minimum	7.30 hrs.	14.30 hrs.		
Aug.'92	31	30.67	25.01	94.94	80.51	3.04	77.40
	32	31.96	25.06	95.64	77.67	4.53	91.90
	33	31.44	24.77	94.94	75.05	3.34	69.10
	34	31.64	25.30	91.67	70.05	3.96	5.60
Sept.'92	35	31.84	25.34	92.57	72.23	2.87	19.50
	36	29.17	24.09	96.05	85.33	2.56	166.10
	37	31.84	23.26	94.15	66.84	8.20	13.20
	38	33.98	22.74	87.22	47.52	9.97	00.00
Oct.'92	39	36.54	22.06	77.64	35.49	10.16	00.00
	40	36.69	24.33	82.08	44.80	9.66	00.00
	41	33.21	22.17	80.21	48.55	6.59	5.60
	42	33.61	22.19	90.18	45.29	8.06	00.00
	43	33.27	19.60	81.60	35.75	10.00	00.00
Nov.'92	44	33.60	16.40	67.67	24.12	9.83	00.00
	45	33.17	14.00	65.05	21.10	10.01	00.00
	46	32.73	17.17	69.04	35.31	9.84	00.00
	47	29.91	15.20	80.02	36.25	9.87	00.00
Dec.'92	48	30.77	12.93	80.13	32.43	9.66	00.00
	49	31.17	14.67	85.31	36.29	7.36	00.00
	50	29.10	12.74	75.90	33.01	8.59	00.00
	51	29.89	12.87	79.30	35.93	9.31	00.00
	52	29.59	11.45	86.56	35.70	8.44	00.00
Jan.'93	1	30.44	12.69	40.68	40.68	9.29	00.00
	2	28.07	11.34	40.65	40.65	8.73	00.00
	3	27.04	10.79	35.80	35.80	9.67	00.00
	4	28.44	10.57	28.30	28.30	9.97	00.00

3.4 Cropping history of the experimental plot

The details of cropping history of the experimental plot are given in Table 3.3 .

Table 3.3 : Cropping history of the experimental plot

Year	Season	Crop	Fertilizer applied (kg/ha)		
			N	P_2O_5	K_2O
1988-89	Kharif	Tobacco	180	0	0
1989-90	Kharif	Green manuring of sannhemp followed by seed crop of GT 5	180	0	0
1990-91	Kharif	Tobacco	180	0	0
1991-92	Kharif	Green manuring of sannhemp followed by tobacco experiment	As per treatment		

3.5 Experimental details

The details of the experiment are as given below. The plan of lay out is depicted in Fig. 3.1.

3.5.1 Details of layout

1. **Crop and variety** : Tobacco (varieties as per treatments)

2. **Design of experiment** : Factorial R.B.D.

3. **Number of replications** : Three

4. **Number of plots/block** : 18

5. **Total number of plots** : 54

6. **Plot size** : Gross 3.75m x 9.0m = 33.75 m^2

Net plot sizes		Net plot area
2.25m x 5.4m	(S_1)	12.15 m^2
2.25m x 6.0m	(S_2)	13.5 m^2
2.25m x 6.6m	(S_3)	14.85 m^2

7. **Plant population**

Spacing (cm)		Plants/net plot	Plants/ha
75cm x 90cm	(S_1)	18	14,814
75cm x 75cm	(S_2)	24	17,777
75cm x 60cm	(S_3)	33	22,222

8. **Area of one replication (including channels)** : 652.5 m^2

9. **Area of three replication (including channels)** : 1957.5 m^2

10. **Total area of experiment (including channels and roads)** : 2044.5 m^2

3.5.2 Treatment details

Three factors were included in the experiment as described below :

Sr. No.	Factors	Number/ level	Variety/ level	Treatment symbol
1.	Spacing (S)	3	75cm x 90cm	S_1
			75cm x 75cm	S_2
			75cm x 60cm	S_3
2.	Nitrogen (N)	3	100 kg N/ha	N_1
			150 kg N/ha	N_2
			200 kg N/ha	N_3
3.	Variety (V)	2	A 119	V_1
			GT 7	V_2

3.5.3 Treatment combinations

In all there were 18 treatment combinations involving three levels each of spacing and nitrogen and two varieties as given below :

Sr. No.	Treatment combination			Treatment symbol
	Spacing(cm)	Nitrogen (kg/ha)	Variety	
1.	75 x 90	100	A 119	$S_1N_1V_1$
2.	75 x 90	100	GT 7	$S_1N_1V_2$
3.	75 x 90	150	A 119	$S_1N_2V_1$
4.	75 x 90	150	GT 7	$S_1N_2V_2$
5.	75 x 90	200	A 119	$S_1N_3V_1$
6.	75 x 90	200	GT 7	$S_1N_3V_2$
7.	75 x 75	100	A 119	$S_2N_1V_1$
8.	75 x 75	100	GT 7	$S_2N_1V_2$
9.	75 x 75	150	A 119	$S_2N_2V_1$
10.	75 x 75	150	GT 7	$S_2N_2V_2$
11.	75 x 75	200	A 119	$S_2N_3V_1$
12.	75 x 75	200	GT 7	$S_2N_3V_2$
13.	75 x 60	100	A 119	$S_3N_1V_1$
14.	75 x 60	100	GT 7	$S_3N_1V_2$
15.	75 x 60	150	A 119	$S_3N_2V_1$
16.	75 x 60	150	GT 7	$S_3N_2V_2$
17.	75 x 60	200	A 119	$S_3N_3V_1$
18.	75 x 60	200	GT 7	$S_3N_3V_2$

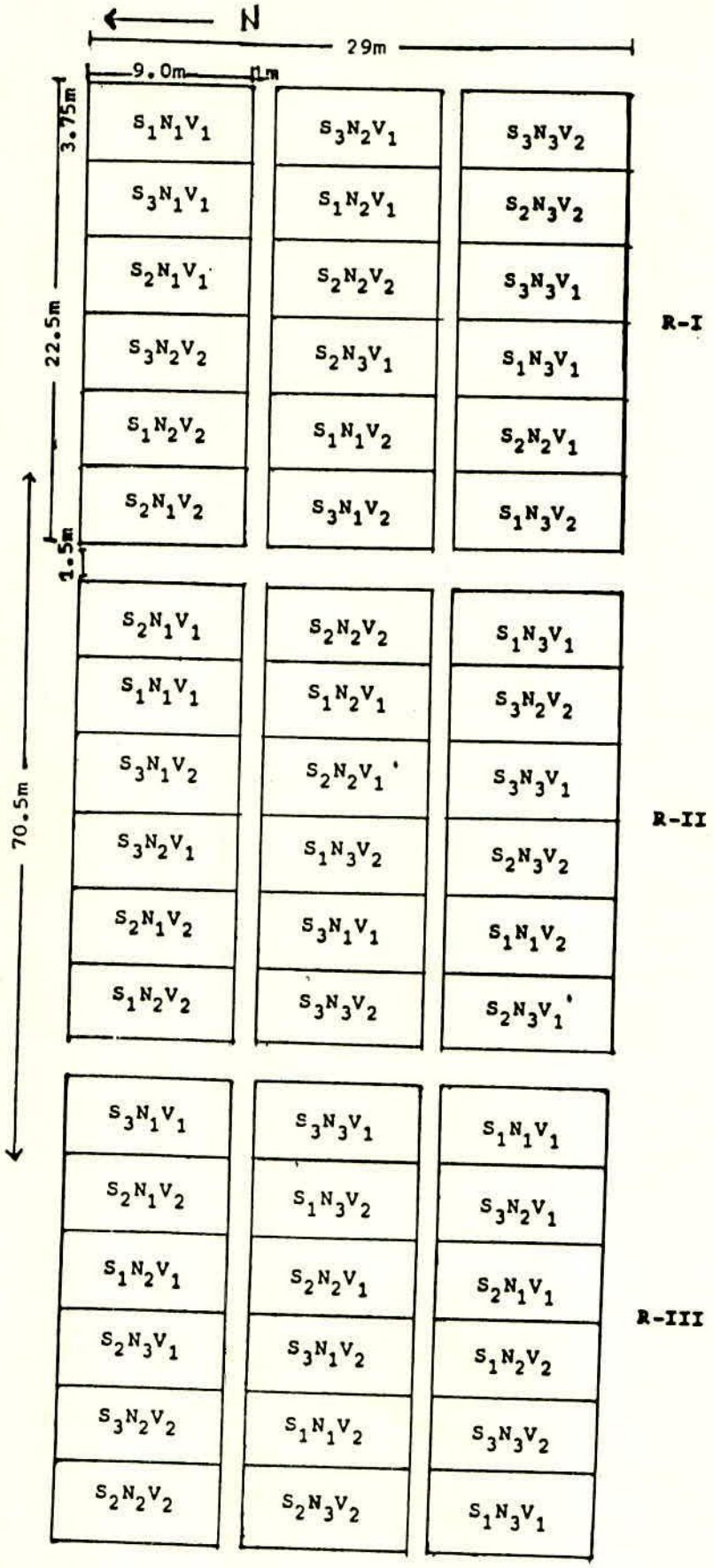

Fig. 3.1 : Plan of Lay out

3.6 Planting material

Two varieties of bidi tobacco were utilized in this investigation. The details about these varieties are given as under :

3.6.1 A 119 (Anand 119)

A 119 (Anand 119) is one of the most predominant bidi tobacco cultivar mostly grown in middle Gujarat. It was developed from a cross between 88-47 x Sokhadiu, following pedigree method of selection. It gave 26 per cent higher yield than K 20, the then cultivated variety of bidi tobacco and was released for general cultivation in 1969. It is a medium tall and erect genotype with long narrow, thick, dark green leaves having acute and abruptly tappering leaf tip. It has moderate puckering as well as spangling and profuse suckering. The finished product is light green in colour with yellow cast. The variety is comparatively resistant to leaf burn disease. It is responsive to nitrogen fertilization and resistant to lodging.

3.6.2 GT 7 (Gujarat Tobacco 7)

The variety GT 7 has been developed from a cross between Anand 2 x Line 930-42. In view of its superiority in yield and acceptable leaf quality it was released for rainfed tobacco cultivated areas of Gujarat in 1993. It has

given 46 to 54 per cent higher yield than existing varieties (A 119, GT 4 and GT 5) under unirrigated condition. It has erect medium stature with fairly round and medium thick stem. It is a medium tall genotype with large green, medium thick leaves having medium suckering, moderate puckering and moderate and less coalescing spangles. It matures in 170 days. The produce (mature leaf) has parrot green colour with the nicotine content of 6.92 per cent under unirrigated condition. It is resistant to lodging. It is more suitable for rainfed condition as it exhibits green turgid leaves even under stress conditions. In respect of quality and other traits it is comparable to existing varieties (A 119, GT 4 and GT 5).

3.7 Cultural operations

3.7.1 Preparation of land

The experimental field was cultivated twice with a tractor drawn cultivator in cross-wise direction when the soil came in vapsa condition. Stubbles and weeds were collected, removed and finally the field was prepared for laying out an experiment.

3.7.2 Application of fertilizer

Nitrogen was applied in the form of ammonium sulphate at three levels (100, 150 and 200 kg N/ha). Ninety per cent of total nitrogen was given before transplanting

as a basal dose, the remaining 10 per cent was given as a top dressing 30 days after transplanting due to delayed rainfall.

3.7.3 Transplanting

Eight weeks old healthy seedlings of bidi tobacco cv. A 119 and GT 7 were selected for transplanting. The transplanting was done on 11th August, 1992.

3.7.4 After care

According to general method of cultivation adopted at Bidi Tobacco Research Station, the operations of gap filling, interculturing, weeding and desuckering were carried out as and when required. The spraying of insecticide was carried out as and when required.

3.7.5 Topping

Topping means the removal of terminal growing bud, which checks the vertical growth of a plant and development takes place horizontally i.e. thickening and widening of leaves, which is desirable. The bidi tobacco variety A 119 was topped at 18 leaves, while GT 7 was topped at 21 leaves.

3.7.6 Harvesting

The crop was harvested when majority of the leaves had spangled and their yellowing had commenced. Harvesting was completed in three rounds.

3.7.7 Calendar of operations

The agricultural operations carried out from land preparation to harvesting of tobacco are given in Table 3.4.

Table 3.4 : Calendar of cultural operations

Sr. No.	Operation	Date
1.	Tractor cultivations (Two)	07.08.92
2.	Removal of stubbles and roots of previous crop	07.08.92
3.	Planking	07.08.92
4.	Lay out of the experiment	07.08.92
5.	Application of basal fertilizers	07.08.92
6.	Light covering of fertilizers with thin layer of soil	07.08.92
7.	Transplanting of seedlings	11.08.92
8.	Gap filling*	12.08.92
9.	Top dressing with ammonium sulphate	10.09.92
10.	Interculturing	17.08.92
		23.08.92
		10.09.92
		14.09.92
		19.09.92
		24.10.92

contd..

Table 3.4 contd..

Sr. No.	Operation	Date
11.	Weeding	22.08.92
		10.09.92
		01.10.92
		13.10.92
12.	Topping and desuckering	13.10.92
		24.10.92
		05.11.92
		23.11.92
		07.12.92
		18.12.92
		20.01.93
13.	Spraying of insecticides :	
	Ekalux 20 EC @ 0.05 %	25.08.92
	Nuvacron 36 WSC @ 0.04 %	01.09.92
	Rogar 30 EC @ 0.03 %	08.09.92
	Nuvacron 36 WSC @ 0.04 %	21.09.92
14.	Collegtion of sand leaves	17.10.92
		05.12.92
		08.01.93
15.	Harvesting of tobacco leaves	21.01.93
		27.01.93
		02.02.93
16.	Removal of stubbles	24.02.93

* As there was heavy rain immediately after transplanting

3.8 Plant characters studied

The yield of crop is governed by the yield attributes. The following plant characters were therefore studied alongwith yield during the course of the investigation.

3.8.1 Plant height

The five plants were selected at random from net plot and tagged for the purpose of plant attributes study. The plant height was measured at maturity stage in cm from the base of the plant to the axil of top leaf.

3.8.2 Leaf length and leaf width (cm)

The leaf length was measured from the base of the leaf to the tip of leaf of selected plants and maximum breadth represented the width of the leaf. The length and maximum width of middle three leaves (leaf nos. 6 to 8 from bottom) of the tagged plants were measured at maturity. They were recorded separately and analysed.

3.8.3 Number of leaves per plant

The number of leaves of selected plants were counted from top to bottom (excluding sand leaves) just before harvest. They were recorded separately and analysed.

3.8.4 Stem girth (cm)

The stem girth was measured from middle part of stem of the five selected plants after leaf harvest.

3.8.5 Growth score

The growth score which is a good indicator of yield potential, was assigned on the basis of growth intensity of the crop. The grade point was given on 0-10 scale.

3.8.6 Spangle score

Spangles are red rusty brown spots on well puckered leaves. It is a criterion for satisfactory maturity and good quality. To judge intensity of spangling score was given depending upon the degree of spangling on the leaf. Unspangled leaf scored zero, whereas leaf having spangle to an extent of 25 per cent area scored 1, 50 per cent spangled area leaf scored 2, 75 per cent spangled area leaf scored 3 and fully spangled leaf scored 4 points.

3.8.7 Cured leaf yield (Kg/ha)

After sun drying the different components of plant, the cured leaf yield was computed by adding the weight of bhuka (lamina), rago (midrib), galia (sand leaves i.e. lower two-three leaves touching to the soil) and geran (portion of lamina pieces adhering to the midrib) together.

3.8.8 Final plant population

After the harvesting of the entire crop was over, stalk count was taken from each net plot area to assess the final plant population.

3.8.9 Green stalk yield (kg/ha)

After the harvest of the entire crop was over, green stalk were cut from ground level from each net plot and weighed. The weight was recorded separately and analysed.

3.8.10 Dry stalk yield (kg/ha)

After recording green weight the stalk were allowed to sun dry. They were weighed at an interval of five days till constant weight was achieved. The weight so achieved was recorded and analysed.

3.8.11 Incidence of root-knot disease

The roots of plants from all the 54 plots were examined after digging the stalks at the end of the season. The root-knot disease index (RKI) was given on 0-5 scale.

3.9 Chemical constituents

3.9.1 Preparation of plant samples

The tobacco cured leaf samples were prepared for chemical analysis by grinding them in a Wiley mill by passing through 60 mesh sieve.

3.9.2 Nicotine (%)

The nicotine content from the cured leaf was determined by Autoanalyser, as per the method of Harvey et al. (1969).

3.9.3 Total nitrogen (%)

Total-N from the cured leaf samples of bidi tobacco was estimated by the Micro Kjeldahl's method (A.O.A.C.,1965).

3.10 Economics

Tobacco produce comprises four components, viz., lamina, midribs, sand leaves and geran for marketing purposes in the proportion of 60 : 20 : 10 : 10, respectively. Entire produce is sold at the same rate on the basis of the quality of the lamina. Merchants judge the quality of the produce by judging the physical characteristics like, colour, lustre, spangling intensity, thickenss, granulation etc. They also smoke bidis prepared from the lamina portion and examine their smoking strength and burning property.

The representative composite lamina samples of the produce from the experimental plots were evaluated by a panel of three merchants. The mean valuation of each treatment was worked out. There was no much difference in manuring treatments. Therefore, variet wise average price was considered.

3.11 Statistical method employed

The data generated on cured leaf yield, quality and various morphological characters were subjected to statistical analysis, using analysis of variance techniques. The value

of calculated 'F' was worked out and compared with the value of table 'F' at the five per cent level of significance. Where the treatment differences were significant, value of C.D. was worked out to compare the treatment effects (Snedecor and Cochran, 1967).

RESULTS

CHAPTER -IV

EXPERIMENTAL RESULTS

The results of the field experiment entitled " Effect of Spacing and Nitrogen Levels on Yield and Quality of Bidi Tobacco Varieties Under Rainfed Condition conducted at BTRS, Gujarat Agricultural University, Anand Campus, Anand during 1992-93, are presented in this chapter alongwith statistical inferences. The data pertaining to growth, yield and chemical characters were subjected to statistical analysis and ' analysis of variance' for these data are given in Appendix I and II with level of significance. Data for all the main effects and only significant interactions are presented in the succeeding paragraphs. Wherever, necessary the results have also been presented graphically.

4.1 Cured leaf yield

The mean data on cured leaf yield (kg/ha) of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.1 and also graphically depicted in Fig. 4.1.

The results showed that differences in cured leaf yield due to different levels of spacing were significant. The linear increase in cured leaf yield was noticed at each decreasing levels of spacing. Among different

Table 4.1 : Mean cured leaf yield of bidi tobacco varieties as influenced by various levels of spacing and nitrogen

Treatment		Cured leaf yield (kg/ha)
Spacing (S)		
75cm x 90cm	(S_1)	1858
75cm x 75cm	(S_2)	1961
75cm x 60cm	(S_3)	2141
S.Em.±		45
C.D.at 5 %		129
Nitrogen (N)		
100 kg/ha	(N_1)	1860
150 kg/ha	(N_2)	2024
200 kg/ha	(N_3)	2075
S.Em.±		45
C.D.at 5 %		129
Variety (V)		
A 119	(V_1)	1707
GT 7	(V_2)	2265
S.Em.±		37
C.D. at 5 %		106
Significant interaction		-
C.V. %		9.6

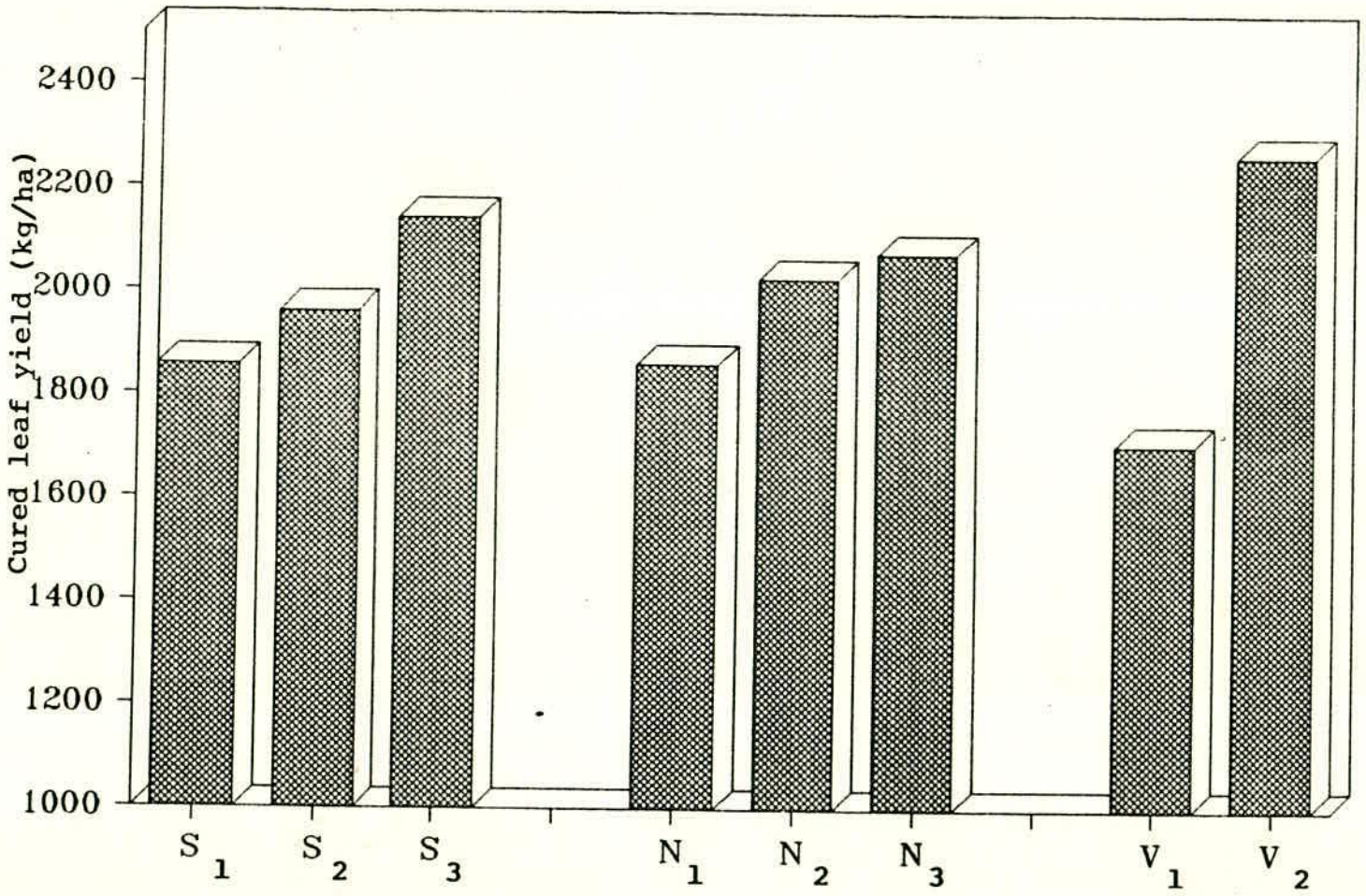

Fig.4.1 Mean cured leaf yield (kg/ha) of bidi tobacco varieties as influenced by different levels of spacing and nitrogen

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levels, S_3 (75 x 60cm) recorded the highest cured leaf yield (2141 kg/ha) and was found significantly superior to S_2 (1961 kg/ha) and S_1 (1858 kg/ha), while spacing levels S_1 (75cm x 90cm) and S_2 (75cm x 75cm) were at par in this respect.

The effect of various levels of nitrogen on cured leaf yield was also significant. Increasing levels of nitrogen resulted in increasing cured leaf yield. Although highest cured leaf yield was obtained at 200 kg N/ha (N_3) it was at par with 150 kg N/ha (N_2), but both these level differed significantly from 100 kg N/ha (N_1). Average cured leaf yield of 1860, 2024 and 2075 kg/ha was obtained with N_1, N_2 and N_3 levels, respectively.

Similarly, significant differences with respect to cured leaf yield were observed due to varieties. Variety GT 7 (V_2) gave significantly higher cured leaf yield than A 119 (V_1). On an average varieties V_1 and V_2 gave 1707 and 2265 kg cured leaf yield per hectare, respectively.

The results revealed that none of the interactions was observed to be significant in respect of cured leaf yield.

4.2 Green stalk yield

The mean data on green stalk yield (kg/ha) of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.2 and the analysis of variance is given in Appendix-I.

Table 4.2 : Mean green and dry stalk yield of bidi tobacco varieties as influenced by various levels of spacing and nitrogen

Treatment		Yield (kg/ha) Green stalk	Yield (kg/ha) Dry stalk
Spacing (S)			
75cm x 90cm	(S_1)	1801	307
75cm x 75cm	(S_2)	1995	333
75cm x 60cm	(S_3)	2323	380
S.Em. ±		78	10
C.D. at 5 %		225	29
Nitrogen (N)			
100 kg/ha	(N_1)	1864	313
150 kg/ha	(N_2)	1984	331
200 kg/ha	(N_3)	2271	376
S.Em. ±		78	10
C.D. at 5 %		225	29
Variety (V)			
A 119	(V_1)	1603	277
GT 7	(V_2)	2475	403
S.Em. ±		64	8
C.D. at 5 %		183	23
Significant interaction		-	-
C.V. %		16.3	12.5

It is evident from the data that the differences in green stalk yield due to different levels of spacing were significant. Among different levels, S_3(75cm x 60cm) recorded significantly highest green stalk yield (2323 kg/ha). The spacing levels S_1(1801 kg/ha) (75cm x 90cm) and S_2 (1995 kg/ha) (75cm x 75cm) were statistically at par.

Differences in green stalk yield due to various levels of nitrogen were also significant. Application of 200 kg N/ha (N_3) gave significantly higher green stalk yield over 150 kg N/ha (N_2) and 100 kg N/ha (N_1). Though, N_2 (150 kg N/ha) recorded numerically higher green stalk yield it was found to be at par with N_1 (100 kg N/ha). Average green stalk yield of 1864, 1984 and 2271 kg/ha was obtained with N_1, N_2 and N_3 levels of nitrogen, respectively.

The data presented in Table 4.2 further indicated that the effect of varieties were significant for green stalk yield. The variety GT 7 (V_2) gave significantly higher green stalk yield per hectare than A 119 (V_1). On an average varieties V_1 and V_2 gave 1603 and 2475 kg green stalk yield per hectare, respectively.

No significant differences were observed with respect to green stalk yield due to various interactions.

4.3 Dry stalk yield

The mean data on dry stalk yield (kg/ha) of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.2 and the analysis of variance is given in Appendix-I.

The results showed that differences in dry stalk yield due to different levels of spacing were significant. A linear increase in dry stalk yield was observed at each decreasing level of spacings. Among different levels, S_3 (75cm x 60cm) gave significantly higher dry stalk yield (380 kg/ha) than S_2 (333 kg/ha) and S_1 (307 kg/ha). Though S_2 (75cm x 75cm) recorded numerically higher dry stalk yield it was found to be at par with S_1 (75cm x 90cm).

Differences in dry stalk yield due to various levels of nitrogen were significant. Application of 200 kg N/ha gave significantly higher dry stalk yield over 150 kg N/ha and 100 kg N/ha. Whereas, N_2 (150 kg N/ha) and N_1 (100 kg N/ha) were found to be at par in this respect. Average dry stalk yield of 313, 331 and 376 kg/ha was obtained with N_1, N_2 and N_3 levels of nitrogen, respectively.

The significant differences in dry stalk yield were noticed due to varieties. The variety GT 7 (V_2) gave significantly higher dry stalk yield per hectare than

A 119 (V_1). On an average varieties V_1 and V_2 gave 277 and 403 kg dry stalk yield per hectare, respectively.

None of the interactions was found to be significant with respect to dry stalk yield.

4.4 Plant stand

The mean data on plant stand of bidi tobacco varieties at harvest time as influenced by various levels of spacing and nitrogen are presented in Table 4.3 and the analysis of variance is given in Appendix-I.

The data regarding plant stand revealed significant differences among spacings. The closer spacing significantly increased plant stand per net plot. Significantly the highest plant stand was observed with S_3 (31.22), followed by S_2 (22.77) and S_1 (16.94).

The differences in plant stand due to various levels of nitrogen was not significant. The mean plant stand per net plot recorded with 100 kg N/ha (N_1), 150 kg N/ha (N_2) and 200 kg N/ha (N_3) was 23.33, 23.83 and 23.77, respectively.

Similarly, differences in plant stand due to varieties were also found to be non significant. The mean plant stand recorded per net plot was 23.81 and 23.48 in V_1 and V_2 varieties, respectively.

None of the interactions was found to be significant.

Table 4.3 : Mean plant stand and number of leaves of bidi tobacco varieties as influenced by various levels of spacing and nitrogen

Treatment		Final plant stand	Number of leaves
Spacing (S)			
75cm x 90cm	(S_1)	16.94	17.76
75cm x 75cm	(S_2)	22.77	17.61
75cm x 60cm	(S_3)	31.22	17.48
S.Em. ±		0.20	0.21
C.D. at 5 %		0.58	NS
Nitrogen (N)			
100 kg/ha	(N_1)	23.33	17.38
150 kg/ha	(N_2)	23.83	17.53
200 kg/ha	(N_3)	23.77	17.94
S.Em. ±		0.20	0.21
C.D. at 5 %		NS	NS
Variety (V)			
A 119	(V_1)	23.81	16.31
GT 7	(V_2)	23.48	18.93
S.Em. ±		0.17	0.17
C.D. at 5 %		NS	0.50
Significant interaction		-	-
C.V. %		3.6	5.1

NS = Not significant

4.5 Number of leaves per plant

The average number of leaves (excluding sand leaves) per plant of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.3 and the analysis of variance is given in Appendix-I.

The results indicated that number of leaves per plant was not significantly affected by various levels of spacing. However, S_1 (75cm x 90cm) gave numerically the highest number of leaves per plant (17.76) followed by S_2 (17.61) and S_3(17.48).

Similarly, differences in number of leaves per plant due to nitrogen levels were also found to be non-significant. The mean number of leaves per plant recorded with 100 kg N/ha (N_1), 150 kg N/ha (N_2) and 200 kg N/ha (N_3) was 17.38, 17.53 and 17.94, respectively.

However, varieties showed significant differences in number of leaves per plant. Significantly higher number of leaves per plant (18.93) was registered under GT 7 than A 119 (16.31).

The interaction effect for different factors was absent with respect to number of leaves per plant.

4.6 Leaf length

The mean data on leaf length of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.4 and the analysis of variance in Appendix-I.

The data indicate that the leaf length was significantly affected by different levels of spacing. A linear decrease in leaf length was noticed at each decreasing level of spacing. Among different levels, S_1 (75cm x 90cm) recorded the highest leaf length (43.54 cm), which was at par with S_2 (42.05 cm) but differed significantly from S_3 (41.28 cm). The later two levels i.e. S_2 (75cm x 75cm) and S_3 (75cm x 60cm) were at par in this respect.

It is apparent from the data that the leaf length was not significantly altered by different levels of nitrogen. The mean leaf length recorded with 100 kg N/ha (N_1), 150 kg N/ha (N_2) and 200 kg N/ha (N_3) was 41.44, 42.53 and 42.91 cm, respectively.

The data in Table 4.4 further indicate that varietal difference was significant for leaf length. The variety GT 7 recorded significantly higher leaf length (44.72 cm) than A 119 (39.86 cm).

None of the interactions was found to be significant.

Table 4.4 : Mean leaf length and leaf width of bidi tobacco varieties as influenced by various levels of spacing and nitrogen

Treatment		Leaf length (cm)	Leaf width (cm)
Spacing (S)			
75cm x 90cm	(S_1)	43.54	19.61
75cm x 75cm	(S_2)	42.05	19.02
75cm x 60cm	(S_3)	41.28	18.84
S.Em. ±		0.59	0.42
C.D. at 5 %		1.70	NS
Nitrogen (N)			
100 kg/ha	(N_1)	41.44	18.71
150 kg/ha	(N_2)	42.53	19.09
200 kg/ha	(N_3)	42.91	19.67
S.Em. ±		0.59	0.42
C.D. at 5 %		NS	NS
Variety (V)			
A 119	(V_1)	39.86	19.04
GT 7	(V_2)	44.72	19.27
S.Em. ±		0.48	0.34
C.D. at 5 %		1.38	NS
Significant interaction		-	-
C.V. %		5.9	9.2

NS = Not significant

4.7 Leaf width

The mean data on leaf width of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.4 and the analysis of variance in Appendix-II.

A perusal of data on leaf width indicated that though there was linear increase in leaf width at each increasing level of spacing the differences were non-significant. The mean leaf width recorded under S_1 (75cm x 90cm), S_2(75cm x 75cm) and S_3 (75cm x 60cm) was 19.61, 19.02 and 18.84cm, respectively.

The leaf width was also not significantly influenced by various levels of nitrogen. However, 200 kg N/ha (N_3) gave numerically the highest leaf width (19.67 cm), followed by N_2 (19.09 cm) and N_1 (18.71 cm).

Similarly, the results showed that differences in leaf width due to varieties were not significant. However, variety GT 7 (V_2) recorded higher leaf width (19.27 cm) than A 119 (19.04 cm).

None of the interactions was found to be significant.

4.8 Final plant height

The mean data on plant height of bidi tobacco varieties at harvest time as influenced by various levels of spacing and nitrogen are presented in Table 4.5 and the analysis of variance is given in Appendix-II.

It is apparent from the data that the plant height was not significantly altered by different levels of spacing. The mean plant height recorded with S_1 (75cm x 90cm), S_2 (75cm x 75cm) and S_3(75cm x 60cm) was 54.63, 55.4 and 56.14cm, respectively.

The effect of various levels of nitrogen on plant height was also not significant. The mean plant height recorded under N_1, N_2 and N_3 levels was 54.72, 54.84 and 56.61cm, respectively.

Further, the difference in plant height due to varieties was also found to be non-significant. However, variety GT 7 gave higher plant height (55.94 cm) than A 119 (54.84cm).

None of the interactions was found to be significant.

4.9 Stem girth

The mean data on stem girth of bidi tobacco varieties at harvest as influenced by various levels of spacing and nitrogen are presented in Table 4.5 and the analysis of variance is given in Appendix-II.

Table 4.5 : Mean plant height and stem girth of bidi tobacco varieties as influenced by various levels of spacing and nitrogen

Treatment		Plant height (cm)	Stem girth (cm)
Spacing (S)			
75cm x 90cm	(S_1)	54.63	6.55
75cm x 75cm	(S_2)	55.40	6.45
75cm x 60cm	(S_3)	56.14	6.28
S.Em. ±		0.67	0.11
C.D. at 5 %		NS	NS
Nitrogen (N)			
100 kg/ha	(N_1)	54.72	6.33
150 kg/ha	(N_2)	54.84	6.43
200 kg/ha	(N_3)	56.61	6.51
S.Em. ±		0.67	0.11
C.D. at 5 %		NS	NS
Variety (V)			
A 119	(V_1)	54.84	6.17
GT 7	(V_2)	55.94	6.68
S.Em. ±		0.54	0.09
C.D.at 5 %		NS	0.26
Significant interaction		-	-
C.V. %		5.1	7.2

NS = Not significant

The results showed that differences in stem girth due to different levels of spacing were not significant. However, S_1 (75cm x 90cm) gave numerically highest stem girth (6.55 cm), followed by S_2 (6.45 cm) and S_3 (6.28).

Similarly, differences in stem girth due to various levels of nitrogen were also found to be non-significant. However, 200 kg N/ha (N_3) registered highest stem girth (6.51 cm), followed by N_2 (6.43 cm) and N_1 (6.33 cm).

The significant differences with respect to stem girth were noticed due to varieties. The variety GT 7 gave significantly higher stem girth (6.68 cm) than A 119 (6.17 cm).

No significant differences were observed with respect to stem girth due to various interactions.

4.10 Growth score

The mean data on growth score of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.6 and the analysis of variance is given in Appendix II. The data are also depicted in Fig. 4.2.

The data pertaining to growth score revealed that the effect of different levels of spacing was significant. A linear increase in growth score was observed at each

decreasing level of spacing. Among different spacings, S_3 (75cm x 60cm) gave significantly higher growth score (5.72) than S_2 (5.30) and S_1 (5.03), later two treatments were at par.

Differences in growth score due to various levels of nitrogen were also found to be significant. Among three levels of nitrogen, 200 kg/ha (N_3) being at par with 150 kg/ha (5.40) recorded significantly higher growth score (5.73) than 100 kg N/ha (4.98).

The significant difference in growth score was also noticed due to varieties. The variety GT 7 gave significantly higher growth score (5.91) than A 119 (4.79).

None of the interactions was observed to be significant with respect to growth score.

4.11 Spangle score

The mean data on spangle score of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.6 and the analysis of variance is given in Appendix-II. The data are also depicted in Fig. 4.2.

It is evident from the data that the differences in spangle score due to different levels of spacing were not significant. However, S_1 (75cm x 90cm) gave numerically highest spangle score (2.21), followed by S_2 (2.19) and S_3 (2.18).

Table 4.6 : Mean growth score, spangle score and root-knot index of bidi tobacco varieties as influenced by various levels of spacing and nitrogen

Treatment		Growth score (0-10)	Spangle score (0-4)	Root-knot index(0-5)
Spacing (S)				
75cm x 90cm	(S_1)	5.03	2.21	0.62
75cm x 75cm	(S_2)	5.30	2.19	0.68
75cm x 60cm	(S_3)	5.72	2.18	0.68
S.Em.±		0.12	0.07	-
C.D. at 5 %		0.33	NS	--
Nitrogen (N)				
100 kg/ha	(N_1)	4.98	2.01	0.67
150 kg/ha	(N_2)	5.40	2.20	0.67
200 kg/ha	(N_3)	5.73	2.38	0.63
S.Em. ±		0.12	0.07	-
C.D. at 5 %		0.33	0.21	-
Variety (V)				
A 119	(V_1)	4.79	2.04	0.69
GT 7	(V_2)	5.91	2.35	0.63
S.Em. ±		0.10	0.06	-
C.D. at 5 %		0.27	0.17	-
Significant interaction		-	-	-
C.V. %		9.2	13.9	-

NS = Not significant

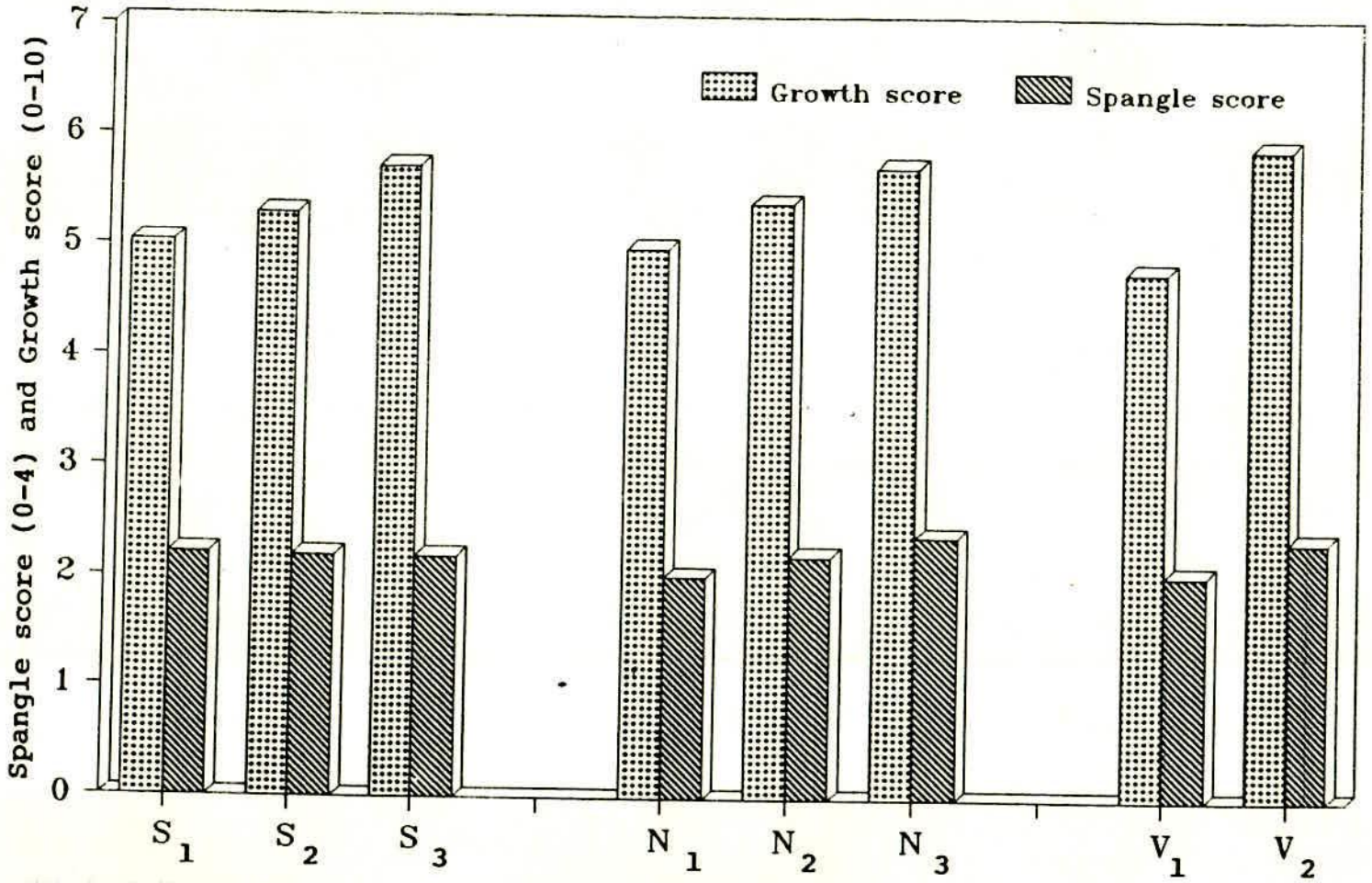

Fig.4.2 Mean spangle score (0–4) and growth score (0–10) of bidi tobacco varieties as influenced by different levels of spacing and nitrogen

The nitrogen levels showed significant differences with respect to spangle score. Among different levels, 200 kg N/ha (N_3) recorded highest spangle score (2.38), which being at par with N_2 (2.20), differed significantly from N_1 (2.01), the later two levels were at par.

The data in Table 4.6 further indicate that the varietal difference was significant for spangle score. The variety GT 7 (V_2) recorded higher spangle score (2.35) than A 119 (2.04).

The significant interaction effect of different factors was absent in respect of spangle score.

4.12 Root-knot index

The data on mean root-knot index of bidi tobacco varieties as influenced by spacing and nitrogen levels are presented in Table 4.6.

Results indicated that the value of root-knot index varied from 0.62 to 0.68 for levels of spacing, 0.63 to 0.67 for levels of nitrogen and 0.63 to 0.69 for varieties. Among different levels of spacing and nitrogen, S_1 (75cm x 90cm) and N_3 ($_2$00 kg N/ha) recorded minimum index viz., 0.62 and 0.63, respectively. Between varieties, GT 7 showed lower root-knot index (0.63) than A 119 (0.69).

4.13 Nicotine

The data on mean nicotine content of bidi tobacco varieties as influenced by various levels of spacing and nitrogen are presented in Table 4.7 and analysis of variance is furnished in Appendix-II.

The results indicated that nicotine content was not significantly affected by different levels of spacing. However, linear increase in nicotine content was noticed at each increasing levels of spacing. Among different levels, S_1 (75cm x 90cm) gave numerically highest nicotine content (6.56 %), followed by S_2 (6.49 %) and S_3 (6.48 %).

Nitrogen levels also showed non-significant differences in nicotine content. However, 200 kg N/ha (N_3) gave numerically the highest nicotine content (6.61 %), followed by N_2 (6.52 %) and N_1 (6.40 %).

Similarly, difference in nicotine content due to varieties was also found to be non-significant. However, variety A 119 (V_1) registered higher nicotine (6.57 %) than GT 7 (6.46 %).

None of the interactions was found to be significant.

Table 4.7 : Mean nicotine and total nitrogen content of bidi tobacco varieties as influenced by various levels of spacing and nitrogen.

Treatment		(Per cent oven dry basis) Nicotine	Total nitrogen
Spacing (S)			
75cm x 90cm	(S_1)	6.56	2.64
75cm x 75cm	(S_2)	6.49	2.54
75cm x 60cm	(S_3)	6.48	2.54
S.Em. ±		0.07	0.05
C.D. at 5 %		NS	NS
Nitrogen (N)			
100 kg/ha	(N_1)	6.40	2.55
150 kg/ha	(N_2)	6.52	2.57
200 kg/ha	(N_3)	6.61	2.61
S.Em. ±		0.07	0.05
C.D. at 5 %		NS	NS
Variety (V)			
A 119	(V_1)	6.57	2.55
GT 7	(V_2)	6.46	2.60
S.Em. ±		0.06	0.04
C.D. at 5 %		NS	NS
Significant interaction		-	S x N x V
C.V. %		4.8	7.9

NS = Not significant

4.14 Total nitrogen

The data on mean total nitrogen content of bidi tobacco varieties as influenced by different levels of spacing and nitrogen are presented in Table 4.7 and the analysis of variance is given in Appendix-II.

From the data, it is noticed that the total nitrogen content was not significantly influenced by various spacings. However, S_1 (75cm x 90cm) gave numerically highest total nitrogen content (2.64 %), followed by S_2 (2.54 %) and S_3 (2.54 %).

Similarly, differences in total nitrogen content due to various levels of nitrogen were also found to be non-significant. The mean total nitrogen content recorded with 100 kg N/ha (N_1), 150 kg N/ha (N_2) and 200 kg N/ha (N_3) was 2.55, 2.57 and 2.61 per cent, respectively.

The data in Table 4.7 further indicated that the varietal difference was not significant for total nitrogen content of leaf. However, variety GT 7 (V_2) was found to be richer in nitrogen content than A 119 (V_1). Total nitrogen content in V_1 and V_2 varieties was 2.55 and 2.60 per cent, respectively.

Among various interactions only S x N x V interaction was significant for total nitrogen content and the mean data for the same are presented in Table 4.8. The

perusal of the mean data indicate that treatment combination $S_2N_3V_2$ gave significantly higher (2.85 %) total nitrogen content than $S_1N_2V_2$, $S_2N_1V_2$, $S_2N_2V_1$, $S_2N_3V_1$, and $S_3N_1V_1$ combinations, but it remained at par with remaining treatment combinations.

4.15 Economics

Average cured leaf yield of tobacco, gross realization, cost of cultivation, net profit and CBR for various treatments was worked out and the data are presented in Table 4.9.

The data pertaining to average net realization derived from the main effect presented in Table 4.10 indicated that among various spacings, 75cm x 60cm gave the maximum net profit (Rs. 9527/ha), followed by 75cm x 75cm (Rs. 8037/ha) and 75cm x 90cm (Rs. 7182/ha) spacings.

Among the various levels of nitrogen 150 kg/ha gave the maximum net profit (Rs. 8588/ha), followed by 200 kg N/ha (Rs. 8533/ha) and 100 kg N/ha (Rs. 7623/ha).

Between the two varieties of bidi tobacco, newly evolved variety GT 7 gave maximum net profit of Rs. 10757/ha while A 119 accrued net profit of Rs. 5739/ha.

Table 4.8 : Mean total nitrogen content of bidi tobacco varieties as influenced by the interaction effect of spacing x nitrogen x variety (S x N x V)

Treatment combination	Total nitrogen (%)
$S_1N_1V_1$	2.68
$S_1N_1V_2$	2.68
$S_1N_2V_1$	2.63
$S_1N_2V_2$	2.46
$S_1N_3V_1$	2.74
$S_1N_3V_2$	2.68
$S_2N_1V_1$	2.67
$S_2N_1V_2$	2.37
$S_2N_2V_1$	2.38
$S_2N_2V_2$	2.68
$S_2N_3V_1$	2.31
$S_2N_3V_2$	2.85
$S_3N_1V_1$	2.35
$S_3N_1V_2$	2.55
$S_3N_2V_1$	2.65
$S_3N_2V_2$	2.64
$S_3N_3V_1$	2.55
$S_3N_3V_2$	2.53
C.D. at 5 %	0.34

Table 4.9 : Mean cured leaf yield in kg/ha of bidi tobacco, gross realization, cost of cultivation, net profit and CBR as influenced by various treatment combinations

Treatment	Cured leaf yield (kg/ha)	Gross realization (Rs/ha)	Total cost of cultivation (Rs/ha)	Net profit (Rs/ha)	C.B.R.
$S_1N_1V_1$	1372	12348	9025	3323	1:1.37
$S_1N_1V_2$	2048	18432	9025	9407	1:2.04
$S_1N_2V_1$	1680	15120	9536	5584	1:1.58
$S_1N_2V_2$	2100	18900	9536	9364	1:1.98
$S_1N_3V_1$	1723	15507	10047	5460	1:1.54
$S_1N_3V_2$	2222	19998	10047	9951	1:1.99
$S_2N_1V_1$	1614	14526	9100	5426	1:1.60
$S_2N_1V_2$	2102	18918	9100	9818	1:2.07
$S_2N_2V_1$	1748	15732	9611	6121	1:1.64
$S_2N_2V_2$	2236	20124	9611	10513	1:2.09
$S_2N_3V_1$	1758	15822	10122	5700	1:1.56
$S_2N_3V_2$	2307	20763	10122	10641	1:2.05
$S_3N_1V_1$	1648	14832	9225	5607	1:1.60
$S_3N_1V_2$	2376	21384	9225	12159	1:2.31
$S_3N_2V_1$	1887	16983	9736	7247	1:1.74
$S_3N_2V_2$	2493	22437	9736	12701	1:2.30
$S_3N_3V_1$	1937	17433	10247	7186	1:1.70
$S_3N_3V_2$	2501	22509	10247	12262	1:2.19

Table 4.10 : Net realization in Rs/ha of bidi tobacco as influenced by different treatments.

Treatment		Net realization (Rs/ha)
75cm x 90cm	(S_1)	7182
75cm x 75cm	(S_2)	8037
75cm x 60cm	(S_3)	9527
100 kg N/ha	(N_1)	7623
150 kg N/ha	(N_2)	8588
200 kg N/ha	(N_3)	8533
A 119	(V_1)	5739
GT 7	(V_2)	10757

C O S T

Sr. No.	Source	Unit cost (Rs.)	Total Unit	Total cost (Rs.)
1.	Cost of sannhemp seed	4.75/kg seed	100 kg	475.00
2.	Cost of N from ammonium sulphate	10.22/kg N	100 kg	1022.00
			150 kg	1533.00
			200 kg	2044.00
3.	Cultivation charges with tractor	50.00/hr.	17.5 hrs.	875.00
4.	Cost of bullock pair	100.00/day	6 day	600.00
5.	Irrigation charges for sannhemp	5.00/hr.	50 hrs.	250.00
6.	Cost of seeding (including gap filling)	25.00/1000 seedlings	16000	400.00
			19000	475.00
			24000	600.00
7.	Cost of labour	15.00/day	309	4635.00
8.	Cost of Ekalux	330.00/lit.	1 lit.	330.00
9.	Cost of Nuvacron	330.00/lit.	1 lit.	330.00
10.	Cost of Rogar	216.00/lit.	0.5 lit.	108.00

Selling price of tobacco : 9.00 Rs/kg

Considering the various treatment combinations, variety GT 7 fertilized with 150 kg N/ha and spaced at 75cm x 60cm spacing gave maximum net profit of Rs. 12701/ha, followed by GT 7 fertilized with 200 kg N/ha and spaced 75cm x 60cm spacing (Rs. 12262), while, minimum net profit of Rs. 3323 was obtained with variety A 119 at 100 kg N/ha and 75cm x 90cm spacing.

Cost Benefit Ratio (CBR)

Variety GT 7 fertilized with 100 kg N/ha and transplanted at 75cm x 60cm gave the highest CBR (1:2.31) with net profit of Rs. 12159/ha, while the same variety gave the highest net profit of Rs. 12701/ha with 1:2.30 CBR, when fertilized with 150 kg N/ha and transplanted at 75cm x 60cm spacing, followed by variety GT 7 fertilized with 200 kg N/ha and transplanted at 75cm x 60cm spacing by giving net profit of Rs. 12262/ha with 1:2.19 CBR. Minimum CBR (1:1.37) was accured in case of variety A 119, when fertilized with 100 kg N/ha and transplanted at 75cm x 90cm spacing.

DISCUSSION

CHAPTER-V

DISCUSSION

In this chapter, it is contemplated to discuss the variations obtained in growth, yield and quality components of bidi tobacco under the influence of different treatments and their combinations. An attempt has been made to establish the cause and effect relationship in light of available literature.

The results are discussed under the following heads :

5.1 Effect of spacing

5.1.1 Yield and yield attributes

5.1.2 Chemical composition

5.2 Effect of nitrogen levels

5.2.1 Yield and yield attributes

5.2.2 Chemical composition

5.3 Varietal difference

5.3.1 Yield and yield attributes

5.3.2 Chemical composition

5.4 Interaction effect

5.5 Economics

The meteorological data reported in Table 3.2 revealed that the climatic conditions were satisfactory for the crop growth. The crop was free from insect pest and disease

attack. Hence, whatever variations are observed in the various traits could be attributed to the treatment effects employed in the experiment.

5.1 Effect of spacing

5.1.1 Yield and yield attributes

It is evident from the data given in Table 4.1 (Fig. 4.1) that the cured leaf yield of tobacco was significantly highest (2141 kg/ha) under the treatment S_3, while it was significantly lowest (1858 kg/ha) under the treatment S_1. The spacing S_3 gave 15.2 and 9.2 per cent more yield than S_1 and S_2 spacing, respectively. The higher cured leaf yield under treatment S_3 (75cm x 60cm) is evidently due to greater number of plants per unit area (Table 4.3). The similar results were obtained by Patel (1967) and Patel (1971) as well as from investigations carried out at BTRS, Anand (Anon., 1971; Anon., 1977 and Anon., 1978 a).

In respect of green and dry stalk yields (Table 4.2), the spacing treatment of 75cm x 60cm (S_3) recorded significantly higher yield of green stalk (2323 kg/ha) and dry stalk (380 kg/ha) than 75cm x 90cm (S_1) and 75cm x 75cm (S_2). The higher green and dry stalk yields under closer spacing (75cm x 60cm) could be attributed to greater number of plants per unit area (Table 4.3). This ultimately resulted in more number of stalks per unit area, which had contributed to higher yield.

The results pertaining to final plant stand per net plot presented in Table 4.3 revealed significant differences due to spacings. The narrow spacing of 75cm x 60cm (S_3) gave highest plant stand (31.22), followed by S_2 (22.77) and S_1 (16.94) spacings. This is because of more plants per unit area in narrower spacing as compared to wider spacing.

Number of leaves per plant remained unaffected due to different spacings (Table 4.3). This might be due to uniform topping level for a given variety under different spacings.

The results pertaining to leaf length and width presented in Table 4.4 indicate that leaf width was not significantly affected by different levels of spacing but leaf length was significantly influenced due to different spacing treatments. The highest leaf length was recorded with 75cm x 90cm (S_1) spacing, which was at par with S_2 treatment but differed significantly from S_3 spacing, while later two treatments i.e. S_2 and S_3 were at par. The differences in leaf length due to spacings could be attributed to the variation in competition for light, space, soil moisture and nutrition. These factors put together result in reduced photosynthesis under narrow spacing leading to poor leaf development as evident from Table 4.4. These

findings are akin to those reported by Kadam et al. (1952), Sajanani (1957), Patel et al. (1961), Kim et al. (1987) and Patel et al. (1989 a) for different types of tobacco.

The variable effect of spacings was non-significant with respect to plant height (Table 4.5). However, among different spacing treatments, S_3 (75cm x 60cm) treatment tended to increase plant height possibly on account of competition among plants for sunlight. Similar findings were reported from studies conducted at BTRS, Anand (Anon., 1982 a; Anon., 1984 b and Anon., 1986 a).

The stem girth recorded at harvest did not show any differential effect of spacings, but it was slightly higher under treatment S_1 (Table 4.5). This might be due to less number of plants per unit area, which are capable of receiving more sunlight and moisture as well as better nutrition.

The results reported in Table 4.6 indicate that the effect of spacings on growth score was found to be significant. The treatment S_3 recorded significantly higher growth score than S_1 and S_2 treatments (Fig. 4.2). Higher growth score under 75cm x 60cm (S_3) might be due to the fact that this spacing accomodates more number of plants per unit area with more plant height, which showed better appearance (Table 4.3 and 4.5). Similar improvement in the growth score with the increase in plant population was recorded at BTRS, Anand (Anon. 1982 a).

The variable effect of spacings was not significant for spangle score (Table 4.6 and Fig. 4.2). However treatment S_1 (75cm x 90cm) gave numerically higher spangle score (2.21), followed by S_2 (2.19) and S_3 (2.18). Similar response of spacings was observed by Patel (1971). He stated that it was not necessary to have wider spacing as is generally believed for better spangle development. The similar results were recorded at BTRS, Anand (Anon., 1984 b and Anon., 1989 a).

The results (Table 4.6) indicated that the intensity of root-knot disease indidence in the experimental plot was very low in different spacing treatments, hence the differences were not marked.

5.1.2 Chemical composition

Different spacing treatments did not improve nicotine and total nitrogen contents of leaf upto a level of significance (Table 4.7). However, treatment S_1 (75cm x 90cm) recorded highest nicotine content (6.56 %), followed by S_2 (6.49 %) and S_3 (6.48 %). Garner (1951) pointed out that wider spacing of plants in the field condition tends to increase in the accumulation of nicotine in the leaf. Thus, improvement in nicotine content of leaf lamina with wider spacings could be due to reduction in the competition among plants for availability of nitrogen in soil. Similar non-significant positive increases in nicotine content of leaf with increase in spacing were noted by Patel (1971), Tripathi et al. (1986) and investigation carried out at BTRS,

Anand (Anon., 1982 a). In case of total nitrogen content of leaf, treatment S_1 gave numerically higher total nitrogen content (2.64 %) than S_2 (2.54 %), and S_3 (2.54 %) treatments. This could be attributed to the inter plant competition for nitrogen availability. Though non-significant, similar positive increases in total nitrogen content of leaf were observed by Patel (1971).

5.2 Effect of nitrogen levels

5.2.1 Yield and yield attributes

Significantly higher cured leaf yield (2075 kg/ha) was obtained under 200 kg N/ha (N_3), which being at par with 150 kg N/ha (2024 kg/ha) differed significantly from 100 kg N/ha (1860 kg/ha) (Table 4.1 and Fig. 4.1). The intermediate level (150 kg N/ha) was also significantly superior to N_1. The increase in cured leaf yield due to 150 and 200 kg N/ha was to the tune of 8.8 and 11.6 per cent over 100 kg N/ha. The increase in cured leaf yield with increasing levels of applied nitrogen could be due to increase in leaf length, leaf width (Table 4.4), growth score (Table 4.6) and leaf thickness as nitrogen is known to increase vegetative growth by way of increasing both cell division and cell multiplication. Though non-significant similar positive increases in yield attributing characters were observed by Patel (1987) and Hadiyal (1989). The

increase in the yield beyond 150 kg N/ha was not significant possibly on account of development of moisture stress, which might have hampered the availability of applied nitrogen to the fullest extent, while under irrigated condition crop has responded upto 300 kg N/ha (Markose and Patel, 1977). Similar results were obtained at BTRS, Anand for other varieties (GT 4, 123-22 and 3-58-38) grown under rainfed condition (Anon., 1982 b).

The green and dry stalk yields were significantly increased under 200 kg N/ha over 100 and 150 kg N/ha (Table 4.2). The green stalk yield of 2271 kg/ha and dry stalk yield of 376 kg/ha were recorded under 200 kg N/ha. The significantly highest yield of green stalk could be due to increase in the height of plant and girth of the stem (Table 4.5) due to increased nitrogen application. In case of dry stalk yield 200 kg N/ha gave highest yield on account of highest green stalk yield in this treatment. Such increases in green and dry stalk yields upto 200 kg N/ha have been reported by Patel (1991) in bidi tobacco variety GT 5.

Different levels of nitrogen had non-significant effect on final plant stand (Table 4.3). The non-significant differences among nitrogen levels indicate that the levels tried under the present investigation had no adverse effect on the establishment of the seedlings.

Regarding number of leaves per plant (Table 4.3), nitrogen levels had non-significant influence. This might be due to the fact that, the topping level was uniform for a given variety under different nitrogen levels.

It was apparent from the data presented in Table 4.4 that the influence of various levels of nitrogen was non-significant for leaf length and leaf width. However, it showed improvement with the increase in the rate of applied nitrogen. Treatment N_3 recorded higher leaf length (42.91 cm) and width (19.67 cm) than N_1 and N_2 treatments. This might be due to better cell division and cell enlargement at higher rate of applied nitrogen resulting into increase in leaf size. These findings are in accordance to those reported by Patel (1956); Patel (1960) and Patel (1991).

The variable effects of nitrogen levels were non-significant with respect to plant height and stem girth (Table 4.5). However, with the increase in nitrogen application from 100 to 200 kg/ha there were increases in plant height and stem girth, because nitrogen is important for increasing vegetative growth of the plant.

The growth score due to different levels of nitrogen was remarkably affected and the treatment N_3 (200 kg N/ha) being at par with N_2 (150 kg N/ha) recorded

the highest growth score (5.73). The lowest growth score was obtained under the treatment N_1 (Table 4.6 and Fig. 4.2). The higher growth score under treatment N_3 on account of application of nitrogen might have accelerated vegetative growth and ultimately increased photosynthesis which might have resulted in better leaf length and width, taller plants and more stem girth and thereby the better growth score. This finding are in agreement with those reported by Patel (1991).

Significant differences with respect to spangle score were noticed due to different levels of nitrogen (Table 4.6). The highest spangle score (2.38) was obtained under the treatment N_3, which being at par with N_2 differed significantly from N_1 (Fig. 4.2). The later two treatments i.e. N_1 and N_2 remained at par. Similar results were reported by Patel (1991).

The root-knot disease incidence under different nitrogen levels was very low (Table 4.6).

5.2.2 Chemical composition

Different nitrogen levels had non-significant effect on nicotine content of leaf (Table 4.7). However, treatment N_3 recorded comparatively higher nicotine than other treatments. The increase in nicotine content of lamina with increase in nitrogen application could

be possibly on account of the direct relationship between the nitrogen and nicotine contents in tobacco. At BTRS, Anand it was observed that increase in levels of nitrogen application increased nicotine content in bidi tobacco (Anon., 1992 b), while Patel et al. (1989 b) and work carried out at BTRS, Anand (Anon., 1990 c) showed non-significant response of N levels on nicotine content of leaf lamina.

Total nitrogen content of leaf remained unaffected due to different levels of nitrogen (Table 4.7). However, treatment N_3 recorded comparatively higher nitrogen content of leaf than N_1 and N_2. The increase in nitrogen content of leaf lamina revealed that bidi tobacco is nitrogen responsive crop and absorbs more nitrogen as its supply increases. Gowaikar and Shah (1961) stated that increase in nitrogen application increased total nitrogen content of bidi tobacco, while non-significant response of nitrogen levels on total nitrogen content of leaf was obtained at BTRS, Anand (Patel et al. 1989 b and Anon., 1990 c).

5.3 Varietal difference

5.3.1 Yield and yield attributes

The varietal difference was significant for cured leaf yield (Table 4.1 and Fig. 4.1). The variety GT 7 (V_2) gave significantly higher (2265 kg/ha) cured leaf yield than

A 119 (1707 kg/ha). The yield increase in GT 7 was to the tune of 32.7 per cent over A 119, a most popular variety among cultivators of this tract. The increase in yield could be due to higher genetic potentiality of GT 7 with respect to number of leaves (Table 4.3) and better growth (Table 4.6) than A 119. These findings are akin to those reported by Lakshminarayana (1993) and from investigation carried out at BTRS, Anand (1993 b).

The green and dry stalk yields were significantly affected due to varieties (Table 4.2). The variety GT 7 (V_2) produced significantly higher green (2475 kg/ha) and dry (403 kg/ha) stalk yield than A 119 (V_1). This seems to be due to a varietal differences in terms of plant height as well as stem girth (Table 4.5), which have contributed to the higher green and dry stalk yields of GT 7 than A 119. Such significant increase in green and dry stalk yield was also reported by Patel (1991) in bidi tobacco variety GT 5 over A 119.

The varietal difference was non-significant for final plant stand but it was significant for number of leaves per plant (Table 4.3). The variety GT 7 (V_2) gave significantly more number of leaves per plant than A 119 (V_1), which is on account of variation in the genetical make up of both the varieties. The variety GT 7 is developed from a cross between Anand 2 and Line 930-42. The variety Anand 2

has a potentiality to put up 20 leaves at button stage as against 28 leaves in case of line 930-42, which might have contributed to higher number of leaves per plant in GT 7. Similarly, Humphries and Wheeler (1963) stated that the leaf number are affected by genotypes. Among bidi tobacco varieties GT 5 and GT 7 have genetic potentiality to put up more number of leaves than A 119, A 2 and GT 4 (Patel, 1991 and Anon., 1993 b).

The varietal difference for leaf length was significant but leaf width it remained unaffected, but GT 7 gave numerically more leaf width than A 119 (Table 4.4). In case of leaf legth GT 7 gave significantly longer leaf (44.72 cm) than A 119 (39.86 cm). The variation in leaf length of different cultivars could be assigned to their genetic make up. Humphries and Wheeler (1963) reported that the leaf size was affected by genotype and environment. Similar genotypic variations for leaf length were recorded at BTRS, Anand (Anon., 1982 b and Patel 1991).

The difference in plant height was found to be non significant due to varieties (Table 4.5). However, GT 7 (V_2) produced taller plants than A 119, as GT 7 was topped by keeping 21 leaves on the plant as against 18 leaves for A 119.

Significant difference with respect to stem girth was noticed due to varieties, wherein GT 7 had significantly more stem girth (6.68 cm) than A 119 (6.17 cm) (Table 4.5). The difference might be due to varietal characteristics. Similar results were observed by Patel (1991) at BTRS, Anand He reported that bidi tobacco variety GT 5 has significantly thicker stem than A 119.

It is evident from the data given in Table 4.6 that the growth score was significantly affected due to varieties, wherein GT 7 recorded higher growth score than A 119 (Fig.4.2). This seems to be due to specific growth habit of the cultivar. In case of GT 7, higher growth score was attributed to its ability to put up more number of leaves, better leaf length and width and more stem girth than A 119 (Table 4.3, 4.4 and 4.5). These findings are akin to those reported by Patel (1991) and obtained from an experiment conducted at BTRS, Anand (Anon., 1993 b).

The varietal difference was significant for spangle score (Table 4.6). The variety GT 7 (V_2) gave significantly higher spangle score than A 119 (Fig. 4.2). The variation in spangle score could be due to varietal differences in spangling ability. These findings are in agreement to those results obtained at BTRS, Anand (Anon., 1982 b and Anon., 1993 b).

The mean data on root-knot disease incidence is given in Table 4.6, which revealed that root-knot incidence was very low in both the varieties.

5.3.2 Chemical composition

The varietal differences for nicotine and total nitrogen content were not significantly affected (Table 4.7). This might be due to inherent capacity of the variety. Similar non-significant varietal differences for nicotine and nitrogen content were observed at BTRS, Anand (Anon., 1984 b). Contrary to this, significant varietal differences in nicotine and total nitrogen content were reported by Jaisani (1987); Patel et al. (1989 b), Patel (1991) and Parmar (1992).

5.4 Interaction effect

None of the interaction effect was found to be significant for any of the characters studied except interaction effect of S x N x V for total nitrogen content of leaf lamina (Table 4.8). In all treatment combinations $S_2N_3V_2$ (variety GT 7, spaced at 75 cm x 75 cm and fertilized with 200 kg N/ha) gave significantly higher (2.85 %) total nitrogen content over $S_1N_2V_2$, $S_2N_1V_2$, $S_2N_2V_1$, $S_2N_3V_1$ and $S_3N_1V_1$, but it remained at par with remaining treatment combinations.

5.5 Economics

A perusal of data (Table 4.10) on economics indicate that average net realization of Rs. 7182, 8037 and 9527/ha, were obtained for S_1 (75cm x 90cm), S_2 (75cm x 75cm) and S_3 (75cm x 60cm), respectively. The highest net realization was accrued with S_3 followed by S_2, while S_1 realized the lowest net realization. The increase in net realization with S_3 was Rs.2345 and 1490/ha over S_1 and S_2, respectively. The differences in the cost of cultivation among S_1, S_2 and S_3 were mainly due to the cost of seedlings utilized.

The differences in cost of cultivation among 100, 150 and 200 kg N/ha were mainly due to the cost of nitrogen applied. The significant increase in yield due to increase in nitrogen application was observed upto 150 kg N/ha. The mean values of net realization for N_1, N_2 and N_3 were Rs.7623, 8588 and 8533/ha, respectively. The N_2 gave 12.66 and 00.64 per cent higher net realization than N_1 and N_3, respectively. Thus, there was a clear indication of law of diminishing return with increasing rate of nitrogen application.

Further, the data (Table 4.10) showed that average net realization for A 119 (V_1) and GT 7 (V_2) were Rs. 5739 and 10757/ha, respectively. Variety GT 7 (V_2) accrued higher net realization than A 119 (V_1).

The overall data (Table 4.9) showed that the treatment combination, $S_3N_2V_2$ involving variety GT 7 planted at 75cm x 60cm and fertilized with 150 kg N/ha stood first in respect of net realization, which amounted to Rs. 12701/ha. This is followed by the treatment combination $S_3N_3V_2$ (GT 7 at 75cm x 60cm and 200 kg N/ha) which gave net realization of Rs. 12262/ha, while the lowest net realization of Rs. 3323/ha was recorded when variety A 119 was planted at 75cm x 90cm with the application of 100 kg N/ha ($S_1N_1V_1$).

Cost benefit ratio (C.B.R.)

The data of cost benefit ratio (Table 4.9) showed that GT 7 spaced at 75cm x 60cm and fertilized with 100 kg N/ha ($S_3N_1V_2$) accrued the highest CBR (1:2.31), which was followed by the same variety (GT 7) planted at 75cm x 60cm and fertilized with 150 kg N/ha ($S_3N_2V_2$) with CBR of 1:2.30. The lowest CBR of 1:1.37 was observed when A 119 was spaced at 75cm x 90cm and fertilized with 100 kg N/ha ($S_1N_1V_1$).

SUMMARY & CONCLUSIONS

CHAPTER-VI

SUMMARY AND CONCLUSION

Field experiment entitled " Effect of Spacing and Nitrogen Levels on Yield and Quality of Bidi Tobacco Varieties Under Rainfed Condition " was carried out at BTRS, Gujarat Agricultural University, Anand Campus, Anand during kharif season of 1992-93.

In all eighteen treatment combinations comprising three levels each of spacing (75cm x 90cm, 75cm x 75cm and 75cm x 60cm) and nitrogen (100, 150 and 200 kg/ha) alongwith two varieties of bidi tobacco viz., A 119 and GT 7 were laid out in a Factorial Randomized Block Design with three replications. The results are summarised as under :

6.1 Effect of spacing

Significant differences were observed in cured leaf yield due to spacing. The cured leaf yield of tobacco was significantly highest (2141 kg/ha) under the treatment S_3. The treatments S_2 (1961 kg/ha) and S_1 (1858 kg/ha) were at par.

In respect of green and dry stalk yields, the spacing treatment of 75cm x 60cm (S_3) recorded significantly higher yield of green stalk (2323 kg/ha) and dry stalk (380 kg/ha) than 75cm x 90cm (S_1) and 75cm x 75cm (S_2) treatments.

The final plant population recorded from net plot area was significant for all the spacings. The narrow spacing

of 75cm x 60cm (S_3) gave highest plant stand (31.22), followed by S_2 (22.77) and S_1 (16.94). However, the number of leaves per plant was not remarkably affected due to spacing treatments.

The leaf length was significantly influenced due to different spacing treatments, wherein significantly highest leaf length (43.54 cm) was recorded with 75cm x 90cm (S_1), which being at par with S_2, (42.05cm) differed significantly from S_3 (41.26 cm) spacing, while later two treatments i.e. S_2 and S_3 were at par. The leaf width was not significantly altered by spacing treatments.

The variable effect of spacings was non-significant with respect to plant height. However, it was gradually increased with decrease in spacing. Similarly, the stem girth recorded at harvest did not show any differential effect of spacings, but it was increased with increase in spacing.

The closer spacing of S_3 (75cm x 60cm) recorded significantly higher growth score (5.72) than that of S_1 (5.03) and S_2 (5.30), while spangle score did not reveal significant variation due to spacing treatments.

Different levels of spacing failed to manifest their significant effect on nicotine and total nitrogen contents of leaf.

6.2 Effect of nitrogen

Significant differences were observed in cured leaf yield due to nitrogen application. Significantly higher cured leaf yield (2075 kg/ha) was obtained under 200 kg N/ha (N_3), which being at par with 150 kg N/ha (2024 kg/ha), differed significantly from 100 kg N/ha (1860 kg/ha). The intermediate level (150 kg N/ha) was also significantly superior to N_1.

Significantly higher yields of green stalk (2271 kg/ha) and dry stalk (376 kg/ha) were registered under 200 kg N/ha (N_3) than that of 100 (N_1) and 150 kg N/ha (N_2).

Final plant stand as well as number of leaves per plant did not show significant variations due to different levels of nitrogen.

The influence of various levels of nitrogen was non-significant for leaf length and width. However, it showed improvement with the increase in the rate of applied nitrogen. Treatment N_3 (200 kg N/ha) recorded highest leaf length (42.91 cm) and width (16.67 cm).

The variable effect of nitrogen levels was non-significant with respect to plant height and stem girth. However, with the increase in nitrogen application there was increase in plant height and stem girth.

The growth score due to different levels of nitrogen was remarkably affected, wherein treatment N_3

(200 kg N/ha) being at par with N_2 (150 kg N/ha), recorded the highest growth score (5.73). The lowest growth score was obtained under 100 kg N/ha (N_1).

The highest spangle score (2.38) was obtained under 200 kg N/ha (N_3), which being at par with N_2 differed significantly from N_1. The later two treatments i.e. N_1 and N_2 were at par.

The nicotine and total nitrogen contents of leaf were not significantly influenced due to various levels of nitrogen.

6.3 Varietal difference

The varietal difference was significant for cured leaf yield. The variety GT 7 (V_2) gave significantly higher (2265 kg/ha) cured leaf yield than A 119 (1707 kg/ha). The yield increase in GT 7 was to the tune of 32.7 per cent over A 119. Similar trend was observed in case of green and dry stalk yields.

Final plant stand remained unaffected due to varieties but number of leaves per plant at harvest was significantly higher under variety GT 7 (V_2) as compared to that of A 119 (V_1).

Significantly higher leaf length was recorded under variety GT 7 (V_2) than A 119 (V_1), whereas, leaf width was not significantly affected due to varieties.

Plant height recorded at harvest did not show differential effect due to varieties, however, it was higher in GT 7 than that of A 119. Variety GT 7 recorded significantly more stem girth (6.68 cm) than A 119 (6.17 cm).

With respect to growth and spangle scores values, variety GT 7 recorded significantly higher values for growth and spangle scores than A 119.

The varietal differences were not significant for nicotine and total nitrogen content of leaf lamina.

6.4 Interaction effect

None of the interaction was found to be significant except interaction effect of S x N x V for total nitrogen content of leaf, wherein treatment combination $S_2N_3V_2$ gave highest (2.85 %) total nitrogen content.

6.5 Economics

The net profit realized with spacing of S_1, S_2 and S_3 was 7182, 8037 and 9527 Rs/ha, respectively. Thus, closer spacing of 75cm x 60cm (S_3) gave highest monetary return, while the wider spacing of 75cm x 90cm (S_1) gave the lowest net profit.

Among the levels of nitrogen, intermediate level (150 kg N/ha) gave the maximum net profit (Rs. 8588/ha), followed by 200 kg N/ha (Rs.8533/ha) and 100 kg N/ha (Rs. 7623/ha).

Between two varieties, GT 7 gave higher net profit (Rs. 10757/ha) than A 119 (Rs. 5739/ha).

The treatment combination $S_3N_2V_2$ involving variety GT 7 spaced at 75cm x 60cm and fertilized with 150 kg N/ha accrued highest net profit of Rs. 12701/ha followed by $S_3N_3V_2$ (Rs. 12262/ha) involving the variety GT 7 planted at 75cm x 60cm and fertilized with 200 kg N/ha.

The highest CBR value (1:2.31) was obtained with the variety GT 7 fertilized @ 100 kg N/ha and planted at 75cm x 60cm ($S_3N_1V_2$), followed by same variety and spacing at 150 kg N/ha (1:2.30) showing practically no difference between the two.

6.6 Conclusion

From the foregoing results it is pertinent that recently released drought tolerant bidi tobacco variety GT 7 is superior than a ruling variety A 119 under rainfed condition. Therefore, it is concluded that if farmers desire to grow bidi tobacco under rainfed condition, they should select GT 7 to accure maximum monetary returns. This variety should be planted at closer spacing of 75cm x 60cm and fertilized @ 150 kg N/ha to get maximum economic advantage.

FUTURE LINE OF WORK

1. The experiment should be repeated atleast for two more years to judge the validity of the results and also to evaluate the seasonal variation, if any.

2. There is a need to plan irrigation experiment alongwith the levels of nitrogen to identify an optimum N level with the amount of irrigation water supplied as farmers usually give one or two irrigations from the water stored in the tanks.

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* Original not seen.

APPENDICES

APPENDIX - I

Analysis of variance for various characters

Source	d.f.	MEAN SQUARE VALUES					
		Cured leaf yield (kg/ha) 10^3	Green stalk yield(kg/ha) 10^3	Dry stalk yield(kg/ha) 10^3	Plant height (cm)	Number of leaves per plant	Leaf length (cm)
Replication	2	208.197	508.416	1.876	7.094	2.651	26.526
Spacing (S)	2	369.072*	1253.562*	25.022*	10.275	0.347	23.737*
Nitrogen (N)	2	227.187*	787.555*	19.043*	20.112	1.502	10.533
S x N	4	3.454	15.088	0.334	4.150	0.774	7.327
Variety (V)	1	4200.197*	10312.951*	211.181*	16.226	92.851*	318.091*
S x V	2	19.657	153.612	1.847	12.139	1.276	3.814
N x V	2	19.470	40.079	0.525	2.853	1.873	3.309
S x N x V	4	9.609	47.126	0.938	7.638	1.769	9.325
Error	34	36.542	110.276	1.803	7.962	0.815	6.275
Total ...	53						

* Significant at 5 per cent level.

APPENDIX - II

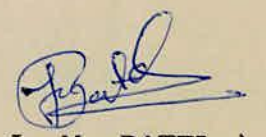
Analysis of variance for various characters

Source	d.f.	MEAN SQUARE VALUES						
		Leaf width (cm)	Stem girth (cm)	Final plant stand	Growth score (0-10)	Spangle score (0-4)	Nicotine (%)	Total nitrogen (%)
Replication	2	25.506	0.872	0.130	1.214	0.523	0.459	0.223
Spacing (S)	2	2.891	0.329	927.574*	2.188*	0.006	0.035	0.060
Nitrogen (N)	2	4.232	0.135	1.352	2.884*	0.603*	0.198	0.017
S x N	4	4.411	0.078	1.241	0.036	0.054	0.179	0.047
Variety (V)	1	0.694	3.630*	1.500	16.957*	1.251*	0.166	0.042
S x V	2	2.122	0.017	0.389	0.448	0.082	0.053	0.073
N x V	2	0.104	0.037	0.056	0.005	0.111	0.028	0.041
S x N x V	4	1.076	0.117	1.444	0.137	0.107	0.048	0.138*
Error	34	3.099	0.216	0.737	0.243	0.094	0.097	0.042
Total ...	53							

* Significant at 5 per cent level

CERTIFICATE

This is to certify that I have no objection for supplying to any scientist only one copy of any part of this thesis for rendering reference service in a library or documentation centre.



ANAND

(**J. M. PATEL**)

DATE : 4th June, 1994