EFFECT OF PLANT AND ROW SPACING ON YIELD AND QUALITY OF FLUE CURED VERGINIA TOBACCO

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ABSTRACT

The experiment on the" effect of plant and row spacing on yield and quality of Flue Cured Virginia Tobacco" was conducted at Tobacco Research Station, Khan Ghari, Mardan during summer 2016-17. The experiment was laid out in randomized complete block design with three replicates and four treatments two plant to plant(45 and 50cm) and two row spacing (90cm and 120cm). Findings of the data revealed that plant spacing at 45 cm resulted in long stature plants, more number of green leaves kg^{-1}, cured leaves kg^{-1}, cured and green leaf yield whereas leaf area, nicotine , and sugar contents was higher in 50 cm apart plant spacing. Likewise, 90 cm apart row spacing fetched higher green and cured leaf yield, plant height and number of leaf area. In case of interaction between row and plant spacing, 90-45 cm spacing produced higher leaf yield, plant height and number of leaves whereas row and plant spacing of 120- 50 cm resulted in larger leaf area, higher nicotine and reducing sugar content. It is concluded that row and plant spacing of 90-45 cm apart resulted in higher green and cured leaf yield and lower nicotine contents whereas reducing sugar was higher for 120-50 cm row and plant spacing.

Key Words: Spacing, Tobacco, Leaf Yield, Nicotine, Reducing Sugar

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INTRODUCTION

Tobacco (*Nicotina tabaccum* L.) locally known as Tambako belongs to family solanacea. It is the second most important cash crop of Pakistan. In world, China is the leading producer followed by Brazil, USA and Turkey. Tobacco is cultivated on area of 64000 ha with production of 138000 tons [10]. Khyber Pakhtunkhwa (KPK) produces 78 % Pakistan's tobacco .Total cultivation area in KPK 36,016 ha [9] , that produces 93,080 tons of tobacco which gives of Rs 10.9 billion .Major districts responsible for tobacco productions in KPK are Swabi 38%, Mardan 25%, Charsadda 15%, Burner 6%, Mansehra 5% and the remaing 11% produces Pakistan tobacco company. It contributes 4.4% the GDP of Pakistan and earns 570.2 million rupees of export which shares in all crops export of Pakistan [1] and tobacco give 30.6 billion rupees indirect taxes which are 5.4% shares in gross income. The yield of the crop can be further increased by number of ways. The spacing between plants in the row and rows determines the number of plant ha^{-1} .The number of plants ha^{-1} have a substantial effect on yield ha^{-1}. One of its options is to arrange proper plant to plant and row to row spacing. Proper plant population and geometry have great influence on the yield and quality of tobacco. Closer spacing put more plants ha^{-1}, however reduced leaf area may result in lesser yield due to the presence of inter competition among the plants. When the spacing exceeds an optimum level, competition among plants for nutrients becomes sever. Consequently plants growth becomes slow and yield decreases. Wider spacing minimized yield due to more weed and pest infestation as well as lower number of plants in unit area. Proper spacing produced higher yield as compared to lower and wider spacing because in lower spacing there were competitions among the plants for nutrition, and in wider spacing yield was affected by weed competition. Hence, proper plant population is the pre-request for higher production and quality of FCV tobacco.

MATERIALS AND METHODS

A field experiment was conducted on the "effect of plant to plant and row to row spacing on yield and quality of FCV Tobacco variety 'Speight, G 28' at Tobacco Research Center Khan Garhi Mardan at year 2016-17. The experiment was laid out in RCB design with three replications and four treatments. 120cm and 90cm was row- row distance and 45cm and 50cm plant-plant distance kept. The plots were adjusted for repetition of treatments. The soil were ploughed well and leveled with the help of wooden plank. Nursery was raised in December 2011. Transplantation was done in March 2012.Nursery was transplanted when seedlings attain a height of 10-13 cm. At all 8-12 irrigations were applied at interval of 7-10 days. Weeding was done manually after establishment of the crop. Topping was done when more than 50% 0f heading completed in each sub plot. For plant height in each plot, 10 plants were randomly selected and were measured

from bottom to the top with the help of meter rod and their means were calculated. In each plot, the 5th, 10th and 15th leaf of 10 plants were measured and average leaf area was then calculated from these three leaf positions by multiplying it with correction factor.

Formula =Leaf length x leaf width x 0.64

Green weight plot^{-1} was measured after each picking by weight balance. The green picking was cured and was weighted again with weight balance. The number of cured leaves was found by measuring the number of cured leaves in each bundle. The leaf yield kg plot^{-1} was calculated and then converted to ha^{-1}.

$$\text{Formula} = \frac{\text{Cured leaf weight plot}^{-1}}{\text{Area harvested}} \times 10{,}000$$

Nicotine content and reducing sugar were determined in laboratory. Data were subjected to analysis of variance (ANOVA) according to the methods described by [11] and means between the treatments were compared by least significance difference ($P \leq 0.05$).

Results and Discussions

Plant height (cm)

Statistical analysis of the data showed that plant and row spacing were significant for plant height of Tobacco. The interaction between plant and row spacing was also found significant. Mean values of the data indicated that 45cm apart plant spacing resulted in long stature plants as compared to 50 cm plant spacing. In case of row spacing, long stature plants were recorded in plots where row to row distance was kept 120 cm as compared to 90 cm. Interaction between plant and row spacing indicated that plant height declined when row to row distance was increased to 120 cm at both plant spacing (Table 1). Increased plant height in lesser spacing might be due to the competition among the plants for space and light. The data were also supported by **[6]** found that increasing plant population enhanced plant height, because in higher plant population there were inter plant competition for light and other resources. In case of row to row spacing, increase spacing between rows enhanced the chances of nutrients availability more as compared to lesser spacing which could be the reason of long stature plants in 120 cm spaced out rows. Similar results were also found by [3] stated that plant height and yield increased in lesser plant spacing as compared to wider spacing because in wider spacing the weeds infestation were more with respect to lesser spacing.

Number of leaves plant^{-1}

Statistical analysis of data revealed that spacing had no significant effect on number of leaves plant^{-1}(Table 1) The data also supported by [6] found that plant population had no significant effect on number of leaves plant^{-1}.

Leaf area (cm^2)

Leaf area was found significant for plant and row spacing of Tobacco. Interaction was also found significant. Mean value of the data showed that 50cm plant spacing resulted larger leaf area as compared to

45cm.Also in case of row spacing the large leaf area was recorded in row to row 120cm as compared to 90cm.The interaction between row and plant spacing indicated that leaf area enhanced with 120cm row spacing and 50cm plant spacing (Table 1) .The larger leaf area in wider spacing would be due to the availability of more space, light and nutrients as compared to lesser spacing. The data also supported by [2] found that leaf length, width and leaf area of the 9th leaf increased significantly in wider row spacing.

Green leaves kg^{-1}

Analysis of data revealed that number of Green leaves kg^{-1} were found significant for plant and row spacing , interaction between plant and row spacing also observed significant .Means of data indicated that plants kept at 45cm distance resulted more number of leaves kg^{-1} as compared to 50cm. In rows spacing more number of leaves were recorded where row to row spacing was kept 90cm as compared to 120cm. Between rows and plants interaction the number of Green leaves kg^{-1} decreased when row spacing kept 120cm at both plant spacing(Table 2). The more number of Green leaves kg^{-1} in lesser spacing might be due to their slighter leaf size and lesser number of leaves kg^{-1} [5].

Cured Leaves kg^{-1}

Data regarding number of Cured Leaves kg^{-1} showed that plant and row spacing was significant for number of cured leaves kg^{-1}. The interaction between row and plant spacing were also found significant. Mean value of data showed that 45cm plant spacing resulted more number of cured leaves kg^{-1}as compared to 50cm. In case of row spacing where the plants in plots kept 90cm resulted in more cured leaves kg^{-1} as compared to 120cm. this might be due to in close spacing the plant compete more for light interception and lesser weeds infestation. Similar findings were also reported by [5] that plant produces more leaves in closer spacing. Interaction between row and plant spacing indicated that 90cm row spacing and 45cm plant spacing resulted more number of cured leaves kg^{-1} with respect to 120cm row and 50cm plant spacing (Table 2).

Green Weight plot^{-1}(kg)

Mean value of data in Table 2 indicated that spacing had no striking effect on Green weight plot^{-1}.It should be due to more number of leaves in close spacing but smaller size and larger leaf size of wider spacing plants.

Cured weight plot^{-1} (kg)

Table 3 showed that cured leaves plot^{-1}(kg) was not significantly inclined by spacing. It should be due to larger leaf size of wider spaced plants and smaller leaf size of close spaced plants. Although their leaf number were more as compared to wider spacing.

Yield ha^{-1}(kg)

Statistical analysis of data delegated that plant and row spacing was significant for Yield kg^{-1} ·The interaction was also found significant .Mean values of the data indicated that 45cm plant spacing resulted high yield as compared to 50cm spacing. Similarly rows spacing the higher yield was recorded where the plants kept in plots at 90 cm row spacing as compared to 120cm. Interaction between plant and row spacing demonstrated that yield abridged when rows spacing was 120cm in both plant spacing (Table 3). The higher yield in close spacing might be due to more number of plants in per unit area. Similar results were also found by [4] stated that tobacco plant grown very faster in wider density as compared to lower density, however higher planting density improved tobacco leaf yield.

Nicotine Contents

Chemical analysis of Tobacco leaf showed that plant and row spacing was significant for Nicotine contents. Interaction was also found significant. Mean values of data revealed that Nicotine contents were more when plant spacing was 50cm as compared to 45cm.In case row to row the Nicotine content was more when spacing was kept 120cm as compared to 90cm. Similarly between interaction the 120cm row and 50cm plant spacing resulted more Nicotine contents as compared to other spacing (Table 4). Similarly, [8] resulted that wider spacing responsible for increasing the quality of tobacco leaf by increasing the reduced sugar and nicotine content.

Reducing Sugar Contents

Data in table 4 assigned that plant and row spacing significantly affected reducing sugar contents in Tobacco leaf. Interaction was also found significant Mean values of data showed that 50cm plant spacing resulted high reducing sugar content as compared to 45cm, between row to row 120cm spacing resulted higher reducing sugar contents. Similarly interaction between plant and row spacing indicated that reducing sugar contents decreased when plant spacing was kept 45cm an row spacing 90cm. Similar results were also found by [7] stated that increasing plant population increased the yield of flue cured tobacco as compared to lesser population; however leaf quality decreased in higher plant population and increased in lower population.

Table 1.Plant height, number of leaves and leaf area as affected by plants and rows spacing.

Treatment	Plant height (cm)	No of leaves plant^{-1}	Leaf area (cm^2)
PxP 45 cm	98.0	16.0	468
PXP 50cm	91.5	17	581
	*	ns	**
RxR 90 cm	68.2	16	491
RxR 120	91.3	17	558
Significance	*	ns	**
Interaction			
90-45 cm	100.7	16	440.0
90-50 cm	95.7	16	543.0
120-45cm	95.3	16	497.0
120-50 cm	87.3	17	620. 0
	*	ns	**

*= Significant at 5 % level of probability.

**= Significant at 1 % level of probability.

ns= non significant

Table .2 Number of Green Leaves kg^{-1}, Cured Leaves kg^{-1} and Green weight kg Plot^{-1} affected by plant and rows spacing

Treatment	Number of green leaves kg^{-1}	Number of curved leaves kg^{-1}	Green weight kg plot^{-1}
PxP 45 cm	31	164	24.5
PxP 50 cm	29	158	23.9
	**	**	ns
RxR 90 cm	33	165	25.5
RxR 120	26	15	22.9
	*	*	ns
Interaction			
90-45 cm	37	169	26.2
90-50 cm	32	160	24.8
120-45cm	27	158	22.9
120-50 cm	27	154	23.0
	*	*	ns

*= Significant at 5 % level of probability.

**= Significant at 1 % level of probability.

ns= non significant

Table.3 Cured weight plot^{-1} and yield kg ha^{-1} as affected by plant and rows spacing

Treatment	Cured weight kg plot^{-1}	Yield kg ha^{-1}
PxP 45 cm	4.2	2646.7
PxP 50 cm	4.1	2495.8
Significance	ns	**
RxR 90 cm	4.2	2712.8
RxR 120	4.1	2429.7
Significance	ns	**
Interaction		
90-45 cm	4.2	28240.
90-50 cm	4.1	2601.7
120-45cm	4.1	2469.3
120-50 cm	4.1	2390.0
Significance	ns	**

*= Significant at 5 % level of probability.

**= Significant at 1 % level of probability.

ns= non significant

Table.4 Nicotine content (%) and Reducing Sugar Content (%) as affected by plant and rows spacing

Treatment	Nicotine content (%)	Reducing Sugar content (%)
PxP 45 cm	1.7	14.5
PxP 50 cm	2.0	15.7
Significance	**	**
RxR 90 cm	1.7	14.4
RxR 120	2.1	15.8
Significance	**	**
Interaction		
90-45 cm	1.7	14.3
90-50 cm	1.7	14.5
120-45cm	1.8	14.7
120- 50 cm	2.4	16.9
Significance	**	*

*= Significant at 5 % level of probability.

**= Significant at 1 % level of probability.

ns= non significant

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