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Boosting Spring Planted Irrigated Maize (*Zea mays* L.) Grain Yield with Planting Patterns Adjustment

[1]*Muhammad Aamir Iqbal and* [2]*Mian Munir Ahmad*

[1]Department of Agronomy, Faculty of Agriculture,
University of Agriculture, Faisalabad-38040, Pakistan
[2]Maize and Millet Research Institute, Yousafwala Sahiwal, Pakistan

Abstract: To investigate the effect of different planting patterns on yield components and grain yield of spring planted irrigated maize, a field trial was executed at Research Area of Maize and Millet Research Institute, Yousafwala Sahiwal, Punjab Pakistan, during 2009. The experimental design was randomized complete block design (RCBD) and was replicated thrice. Maize (cv. Sadaf) was sown in 60, 70, 75, 80 and 90 cm apart rows as experimental treatments. 75 cm spaced maize rows gave the highest grain yield (4155 kg ha^{-1}) and biological yield (9660 kg ha^{-1}). The maximum plant height, number of leaves per plant and stem diameter were also given by 75 cm apart maize rows. The highest number of grains per ear (428) and 1000-grain weight (243.3 g) were also recorded by 75 cm apart maize rows. Thus maize sown in 75 cm spaced rows has the potential to give comparatively higher grain yield.

Key words: Corn · 1000-grain weight · Plant population · Row spacing · Yield components

INTRODUCTION

Maize (*Zea mays* L.) also known as corn in some English speaking countries and locally as makye or makki is one of the most important cereal crops belonging to family Poaceae and tribe Andropogoneae [1]. It is consumed as food, feed and in a variety of industrial products that are useful to mankind. Sugar rich varieties called sweet corn are usually grown for human consumption as kernels, while field corn varieties are used for animal feed. Various corn-based human food uses include grinding it into corn meal, pressing into corn oil, fermentation and distillation into alcoholic beverages and as chemical feed stocks [2, 3]. In Pakistan maize was cultivated on an area of 1.1 million hectares in 2013-14 with production of 4.52 million tons. The area under hybrid maize has superseded the traditional maize varieties. Despite high yield potential of maize, its yield per unit area is very low as compared to advanced countries of the world as an average yield of maize was just over 4 tons ha^{-1} [4]. A variety of seed related, agronomic, soil and climatic factors are responsible for lowering maize grain yield but among agronomic practices, planting pattern holds key to obtain the full potential yield of maize. It is an established fact that management of inputs like improved varieties, irrigation, sowing time, planting pattern, plant population and balanced use of fertilizers has an effective role in enhanced yield of crops. Planting pattern exerts great influence on crops yield [5-7]. However, information on the influence of planting pattern (row spacing) in the changing environment on maize crop production is limited. More than optimum narrow row spacing causes plants to remain barren and results in smaller ear size. In narrow row spacing, plants are prone to lodging, diseases and pest incidence result in decreased grain yield. Whereas, wider row spacing may be considered as a suitable alternate and may result in higher yield as compared to narrow row spacing. Modarres *et al.* [8] evaluated the effect of plant population and row spacing (60 and120 cm) on morphology and yield of maize and found that decreased row spacing and increased population density enhanced grain yield along with days to tasseling and silking. Decreased row spacing took more days to tasseling and silking. Luis [9] studied three row spacing of 50, 75, 100 cm and found a linear increase in yield with reduction in

Corresponding Author: Muhammad Aamir Iqbal, Department of Agronomy, Faculty of Agriculture, University of Agriculture, Faisalabad-38040, Pakistan.

row spacing from 100 to 50 cm in maize. Barbieria *et al.* [10] assessed the effect of row spacing of 35 and 70 cm on maize grain yield and found that 27-46% increased grain yield resulted with narrow row spacing.

This study was designed with the objective of determining the influence of different planting patterns in terms of row spacing on growth and yield of spring planted irrigated maize under climatic conditions of central Punjab of Pakistan.

MATERIALS AND METHODS

A field trial was carried out to investigate the response of maize to different row spacing at the Research Area of Maize and Millet Research Institute Yousawala Sahiwal, Punjab, Pakistan during 2009. The experimental design was randomized complete block design (RCBD) and was replicated thrice. Maize (cv. Sadaf) was sown in 60, 70, 75, 80 and 90 cm apart rows as experimental treatments. The plant to plant distance was maintained at 20 cm. Full dose of recommended phosphorous and half dose of nitrogen was applied at the time of sowing, while remaining nitrogen was applies in two equal splits with first and second irrigation. All agronomic practices were kept same and uniform for all experimental units throughout the growing season. All the data were recorded at 50% tasseling stage by following standard procedures and practices.

Statistical Analysis: Data collected were subjected to two-way ANOVA with the help of MSTAT-C computer software program [11] and least significant difference at 5% probability level was employed to compare treatment means [12].

RESULTS AND DISCUSSION

Plant Height (cm): Plant height is an important indicator of plant growth and development and results revealed that planting patterns had a significant effect on the plant height of maize as 75 cm apart rows gave the highest plant height (163.5 cm) and it was followed by 70 cm apart rows of maize (157.4 cm) (Fig.1). The significantly higher plant height given by 75 cm apart rows was might be due to better utilization of environmental and soil resources as compared to other planting patterns. This finding is in complete agreement as suggested by Rehman [13], Johnson *et al.* [14] and Jones *et al.* [15], who reported that reducing row spacing from 80 cm to 50 cm caused a significant reduction in maize growth.

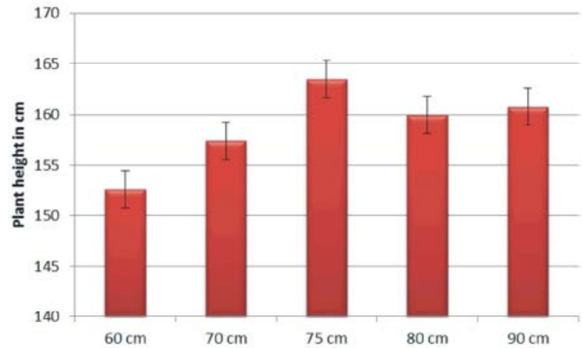

Fig. 1: Plant height (cm) of maize as influenced by different planting patterns.

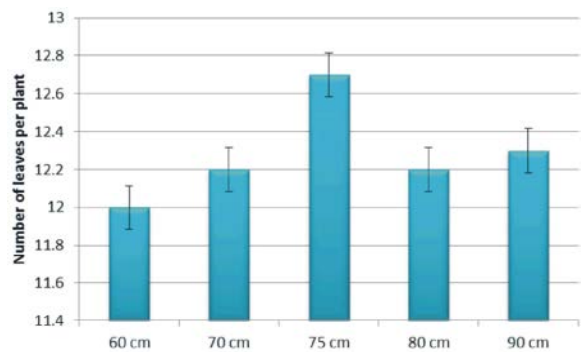

Fig. 2: Number of leaves per plant of maize as influenced by different planting patterns.

Number of Leaves Plant^{-1}, Stem Thickness (cm) and Number of Ears Plant^{-1}: Number of leaves per plant is a key indicator of final yield because leaves are the sites of photosynthesis and more number of leaves result in greater rate of photosynthesis and ultimatly a stronger source-sink relationship accelerates the plant growth. The results revealed that 75 cm row spacing was instrumental in increasing the number of leaves per plant (12.7) as compared to all other row spacings (Fig. 2). This was might be due to the fact that 75 cm row spacing ensured the maximum utilization of soil and environmental resources such as light and these findings are in complete confirmation with Karim [16] Shah *et al.* [17] and Abdulai *et al.* [18], who reported similar results with narrow row spacing. Similarly 75 cm spaced rows gave the maximum stem diameter (5.8 cm) (Fig. 3) as compared to all other row spacing and this was might be due to more photosynthetic activity which resulted in higher thickness of maize stems. These results are in complete agreement with those of Badu and Lum [19], who reported more growth and development of crops when those were sown in optimumly spaced rows as compared to wider spaced rows. Fig. 4 revealed that the effect of row spacing on

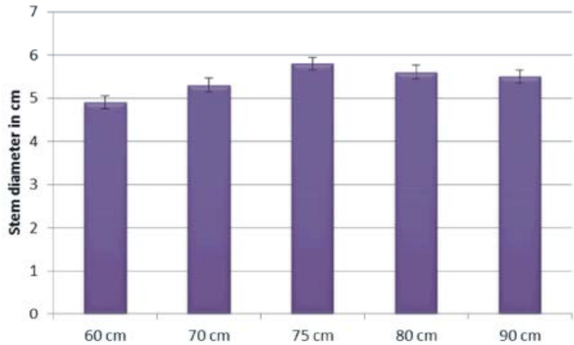

Fig. 3: Stem diameter (cm) of maize as influenced by different planting patterns.

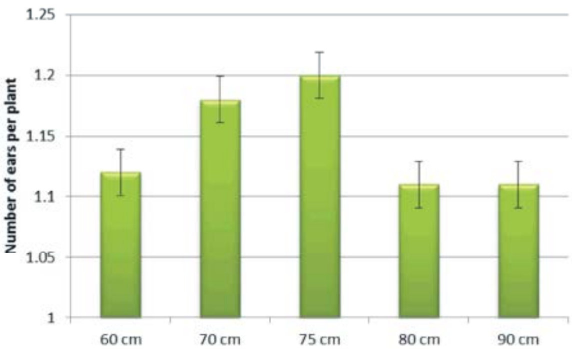

Fig. 4: Number of ears per plant of maize as influenced by different planting patterns.

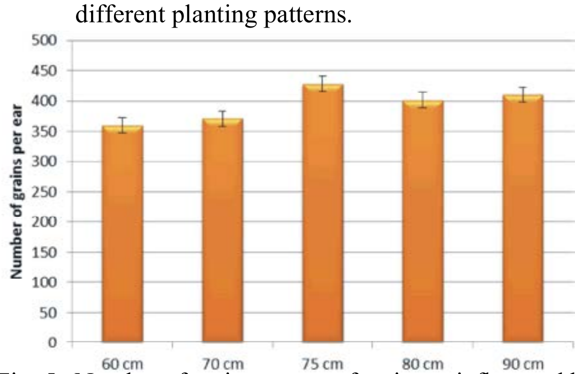

Fig. 5: Number of grains per ear of maize as influenced by different planting patterns.

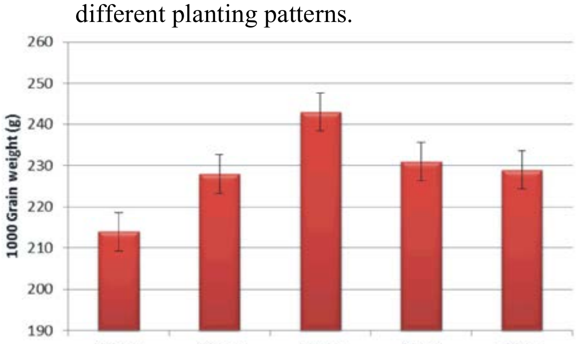

Fig. 6: 1000-grain weight (g) of maize as influenced by different planting patterns.

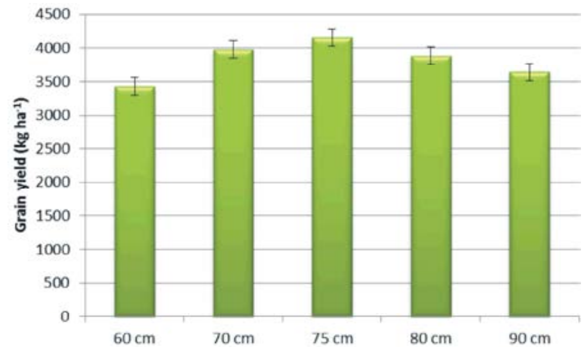

Fig. 7: Grain yield (kg ha^{-1}) of maize as influenced by different planting patterns.

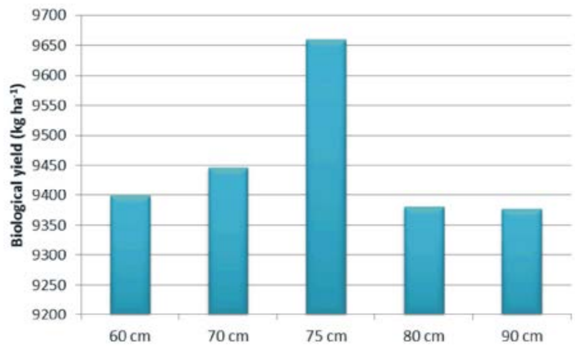

Fig. 8: Biological yield (kg ha^{-1}) of maize as influenced by different planting patterns.

number of ears per plant was non-significant as all the row spacing resulted same number of cobs per ear that were statically at par with each other in complete confirmation with Ogunbodede *et al.* [20] and Bello [21], who reported non-significant effect of planting patterns on number of ears per plant.

Number of Grains Ear^{-1} and 1000-Grain Weight (g): Number of grains per ear is a vital indicator of maize grain yield as more number of grains per ear result in higher economic yield. The maximum number of grains per ear (428) was given by 75 cm apart rows of maize and the minimum number of grains per ear was produced by 60 cm spaced rows (360.5) (Fig.5). 75 cm apart rows of maize gave the highest 1000-grain weight (243.3 g) and it was followed by 70 cm apart rows (Fig.6). These results were might be due to better photosynthesis and utilization of nutrients and moisture and these findings are in line with those of Esechie [22] and Sani [23], who found more vigorous reproductive growth in narrow spaced crops rows.

Grain Yield (kg ha^{-1}) and Biological Yield (kg ha^{-1}): Maize grain yield is sum total of all yield attributes such as plant height, number of ears per plant, number of grains per ear, 1000-grain weight etc. The highest grain yield (4155 kg ha^{-1}) was recorded by 75 cm apart maize rows and it was followed by 70 cm apart maize rows (Fig. 7). The highest biological yield was produced by 75 cm apart maize rows (9660 kg ha^{-1}) and the minimum biological yield was given by 60 cm spaced maize rows (Fig. 8). This was might be due to the better yield attributes such as number of ears per plant, number of grains per ear and other yield attributes given by 75 cm apart maize rows. These findings are in complete agreement with those obtained by Zamir *et al.* [24], Sharifi *et al.* [25], Tollenaar [26] and Xue *et al.* [27], who recorded more grain yield with narrow row spacing of crops.

CONCLUSION

Different planting patterns have a significant effect on the grain yield of maize, however 75 cm spaced maize rows have the potential to give a significantly higher grain yield as compared to other planting patterns. There is a dire need to execute research on different planting patterns in relation to different soil and climatic conditions as well as variety related factors in association with planting patterns are also needed to be investigated.

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