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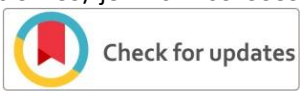

Response of Maize Yield Parameters to Different Inter Row Spacings and Sowing Methods

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***Abstract*—** A field work was conducted to evaluate the response maize yield parameters to different inter row spacing and sowing methods in district Mardan of Khyber Pakhtunkhwa, Pakistan, in 2019. A Randomized Complete Block Design (RCBD) was used for setting the experiment. All the treatments were replicated three times in the experiment. Five treatments i.e. S1 (Flat sowing with inter row spacing 0.60 m), S2 (Ridge-Furrow sowing with inter row spacing 0.60 m), S3 (Ridge-Furrow sowing with inter row spacing 0.75 m), S4 (Bed sowing with inter row spacing 0.60 m, in two row sowing, bed width 0.60 m) and S5 (Bed sowing with row spacing 0.75 m, in two row sowing, bed width 0.60 m) were evaluated. After performing the statistical analysis of the recorded data, it was noted that flat treatment S1 produced statically significant ($P<0.05$) higher kernel number (4.74 × 107 ha-1). While S5 produced minimum (3.52 × 107 ha-1) kernel number. Statistically no difference was observed in kernel number for S2, S3 and S4. Similarly, no significant difference was examined for number of rows per ear, number of kernels per row and number of kernels per ear among the different sowing methods. Therefore, it was concluded that to maximize maize kernel number (yield) it is suggested to use the flat method of sowing keeping the inter row spacing 0.60 m.

Keywords— Maize, Sowing methods, inter row spacing. Yield parameters.

I. Introduction

Transformers Agriculture is confronting a big challenge in completing the demand for agricultural products due to increasing population. Increasing population is a serious threat to food security. To reduce this food insecurity, the per hectare yield of major crops (like maize, wheat, rice etc.) should be increase [1]. According to a researcher, by 2050 the projected population will twice the present food requirements. To fulfill this demand the grain production need to be increased by 40 % [2].

In some (western) parts of the world, the term corn is interchangeably used for maize. This is because under early American and British trade all grains were called as corn. At that time Maize was the most commonly used grain for commerce so, the name also retained for it. It is believed that maize have originated from Mexico about 7000 years ago [3]. In the world almost 1050 million metric tons of maize produced in 2017 [4]. He added that FAO has forecasted that by 2050, 1200 million metric tons of maize will be harvested from only 200 million hectares of area.

In Pakistan about 60 percent maize production is used as a source of food for poultry purposes, 25 percent in different industries and the rest is used as a staple source of food by the human and animals [5]. Punjab and Khyber Pakhtunkhwa (KPK) is contributing 39% and 56% of the total area under maize respectively, similarly Punjab contributes 30% of the total production, KPK 63%, while Sindh and Baluchistan 5 % and 3 % [6]. Maize is mainly used for two purposes; primarily its grain is used as a source of food by humans and poultries also in various industries for extracting oil. Secondly, for farm animals it is used for forage purpose [7]. It has been predicted that by end of 2020 world population may reach over eight (8) billion [8]. Another prediction is that by the end of this century at least ten million people will remain hungry due to unavailability of food products [8].

Different planting techniques are used for raising the maize crop. The purpose of this study is to investigate the combine effect of both the sowing methods and inter row spacing on maize yield parameters in semi-arid region.

II. Materials and Method

Experiment was performed on summer maize in July 2019, in District Mardan. It is located (34º23′27″N, 71º55′33″E, 393 m Altitude) in Khyber Pakhtunkhwa, North of Pakistan. The site is semi-arid with mean annual precipitation of 557 mm occurs. Most rainfall occurs in the month of August. June is the hottest (41ºC) and January is the coldest (11ºC) month. The climate data was collected from the Sugar Crops Research Institute, Mardan, KPK, Pakistan. The Figure 1 represents the data concerning the temperature and precipitation of the experimental site.

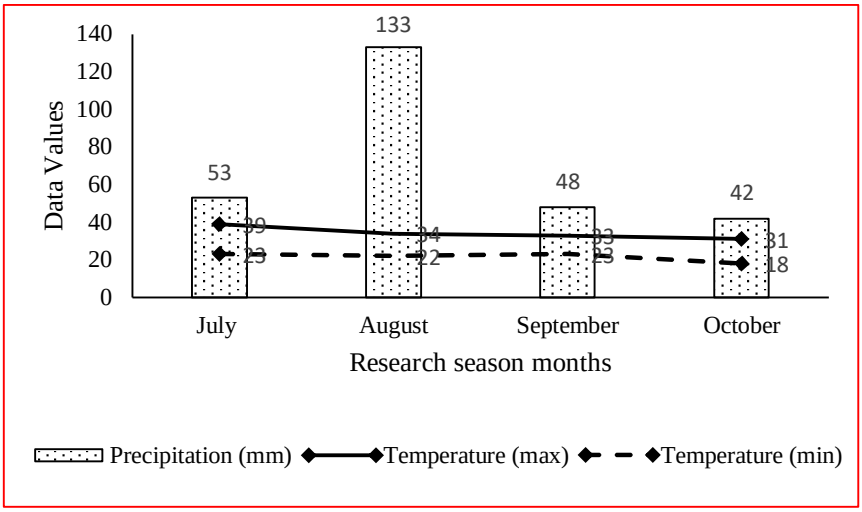

Figure 1: Precipitation and Temperatures at the experimental site

Before going towards the process of sowing the site was well irrigated. After attaining a proper soil moisture, the field was tilled properly two times to make the field fine for sowing. Fifteen plots of equal sizes (length 700 cm and width 610 cm) but of different patterns were made. Flat sowing method S1 row spacing 0.60 m, ridge method (S2) row spacing 0.60 m and ridge method (S3) row spacing 0.75 m, bed method (S4) row spacing 0.60cm and bed method (S5) row spacing 0.75 m were made in the field. A maize planter was used for sowing purpose to keep constant plant to plant distance. The plots were plotted according to a randomized complete block design. After one week, the area having no seedling emergence were refilled to maintain proper plant density. The fertilizer NPK was given to the fields i.e. ratio of 160:80:60 kg ha-1 as recommended by the Pakistan Agriculture Research Council (PARC). All the plots were well protected during the study period. Sketch of the five randomly assigned plots is given below:

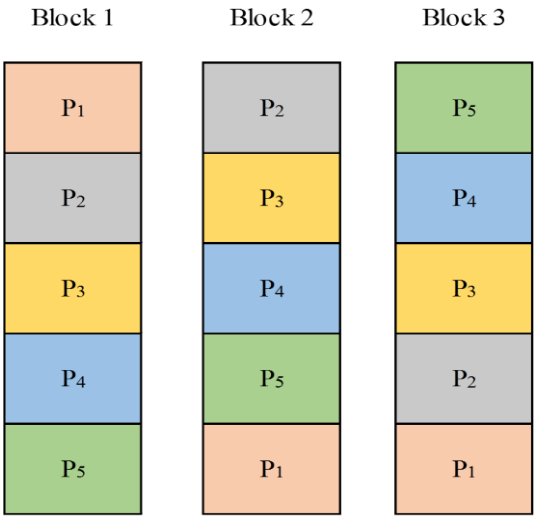

Figure 2: Sketch of randomly assign five sowing methods replicated three times

Data regarding the yield parameters is:

A. Number of Kernel Rows (ear-1)

Three average ears from each plot were selected. The number of rows in each ear was counted. The average number of rows per ear was calculated for each pattern.

B. Number of Kernels (row-1)

The ears taken for counting number of rows per ear, were used for counting the number of kernels per row. The number of kernels in each row was counted and averaged to calculate the number of kernels per row for each pattern.

C. Number of Kernels (ear-1)

After counting the number of rows and kernels in each row, the number of kernels per ear was calculated. The number of rows per ear were multiplied with the number of kernels per ear to get the number of kernels per ear. The average number of kernels ear-1 were taken for analysis purpose.

D. Kernels Number (ha-1)

At maturity stage (100 days after sowing) five representative ears from the center rows of the patterns were selected. The number of kernels per ear was counted. From the average number of kernels per ear, the number of kernels per treatment was calculated. The calculated number of kernels per treatment were converted to kernels per hectare.

According to completely randomized block design (CRBD) the data was analyzed [9] using MS-Excel and Statistix 8.1 software. Analysis of variance (ANOVA) and a pair wise multiple comparison of the five treatment mean values were calculated by the least significant difference test (LSD) at five percent level of probability.

III. Results and Discussions

A. Number of Kernel Rows (ear-1)

After statistical analysis of the recorded data (Table 1) it was observed that sowing method and row spacing combination

has no significant (P<0.05) effect on the number of kernel rows per ear. However, maximum kernel rows (14) were found in S1, S2 and S5. S3 and S4 produced 13.3 rows per ear (Figure 3). [10] have observed 15.44 kernel rows per ear using 60000 planting density as in our case in S5.

TABLE I. EFFECT OF PLANTING PATTERN AND ROW SPACING ON MAIZE YIELD PARAMETERS

Treatments	Number of kernel rows (ear^{-1})	Number of kernels (row-1)	Number of kernels (ear^{-1})	Kernels number $\times 10^7$ (ha^{-1})
S_1	14.00[a]	40.00[a]	556.00[a]	4.74[a]
S_2	14.00[a]	37.67[a]	527.33[a]	4.44[ab]
S_3	13.33[a]	41.33[a]	550.67[a]	3.41[ab]
S_4	13.33[a]	40.00[a]	532.67[a]	4.12[ab]
S_5	14.00[a]	39.33[a]	568.00[a]	3.52[b]
CV (%)	13.82	7.19	15.27	14.48

Means sharing the same letter (s) do not differ significantly at 0.05 level of probability.

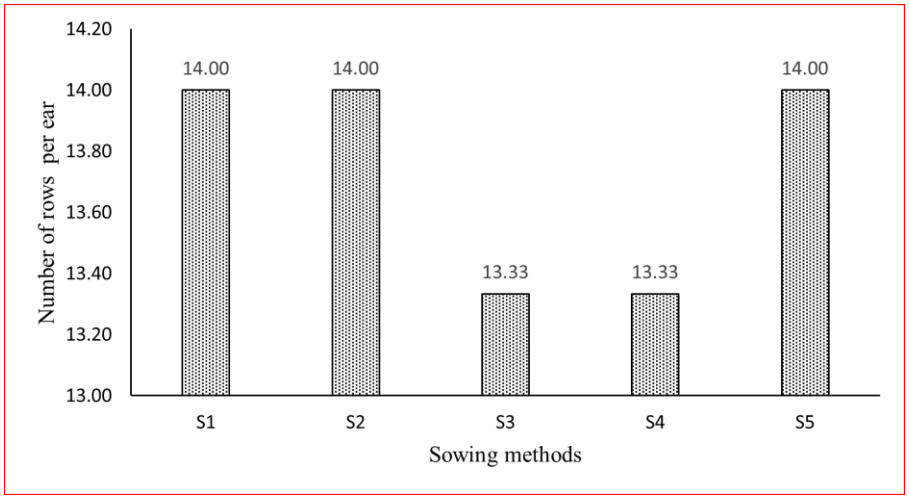

Figure 2: number of rows per ear in different sowing methods

B. Number of Kernels (row-1)

Data regarding the number of kernels per row was subjected to the statistical software Statistix. 8.1. From the results it was concluded that sowing method and row spacing combination has no significant (P<0.05) effect on the number of kernels per row. Maximum kernel per row (41.33) were observed in S3, while minimum (37.67) were found in S2 patten (Figure 4). [11] has observed the same effect that high plant density reduces the number of kernels per row as compared to low density.

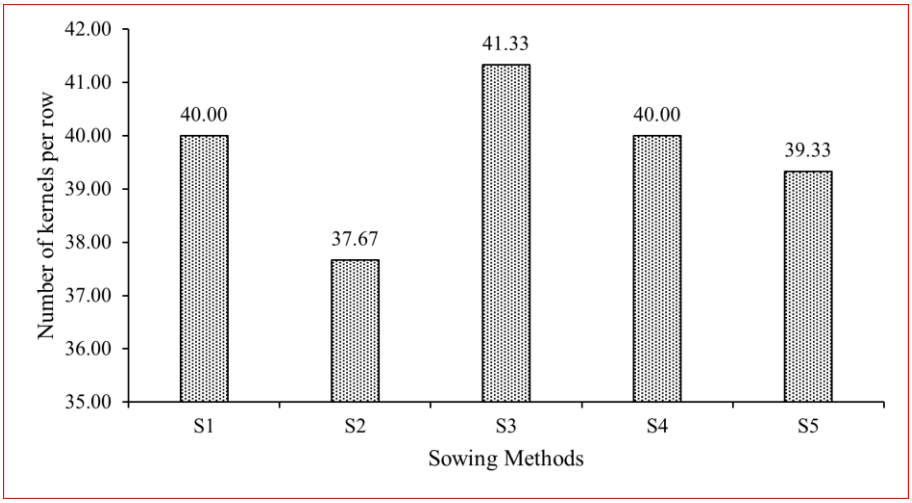

Figure. 3: Number of kernels per row in different sowing methods

C. Number of Kernels (ear-1)

Number of kernels per ear were analyzed to test the effect of different sowing methods and row spacings on the number of kernels per ear. it was observed that sowing method has not significantly (P<0.05) effected the kernels number per ear. However, maximum kernels per ear (568) were found in S5, followed by S1 (556) and S3 (550.67). S2 produced minimum (527.33) kernels per ear (Figure 5). [11] has concluded the same effect, that increased plant density reduces the kernel number per ear. [12] have observed maximum number of kernels (439.8) in ridge planting method followed by flat (412.8) as in our case.

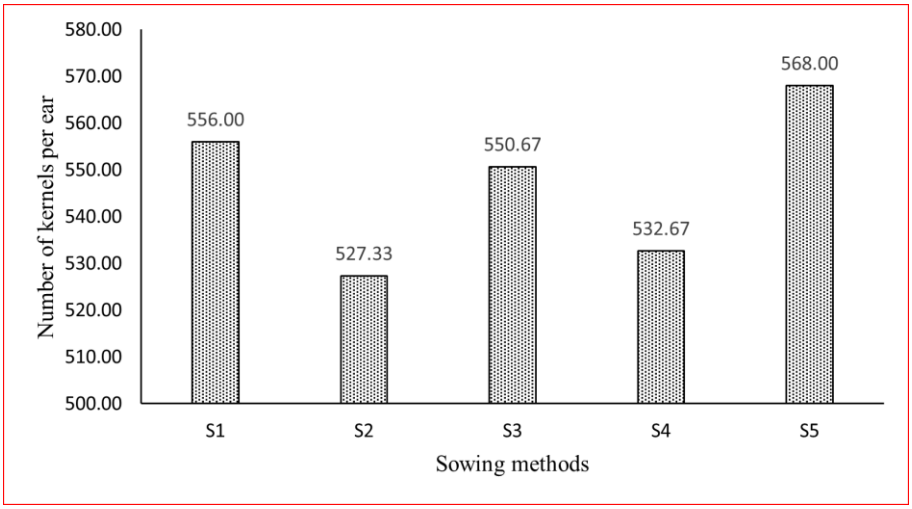

Figure. 4: Number of kernels per ear in different sowing methods.

D. Kernels Number (ha-1)

The data concerning to kernel number of maize plants as affected by different row spacings is presented in Figure 6. The statistical analysis of the data given in Table 1, revealed that planting pattern has a significant (P<0.05) effect on kernel number. Maximum (4.74×107 kernel ha-1) kernel number was observed in pattern S1 followed by S2 (4.44×107 kernel ha-1) while the minimum (3.41×107 kernel ha-1) were observed in pattern S3. Pattern P1 had statistically higher KN as compared to pattern S3 and S5. However, S2 and S4 have statistically no difference in their kernel numbers. [13] observed the similar fact. They conducted a field experiment to study the effect of row width and planting density upon the grain yield. They observed maximum grain yield at 90000 plants/ha. They observed 2% and 4% more grain yield as the row widths were narrowed i.e. from 0.76 m to 0.56 and 0.38 m. High plant density increases the kernel number as a result grain yield increas

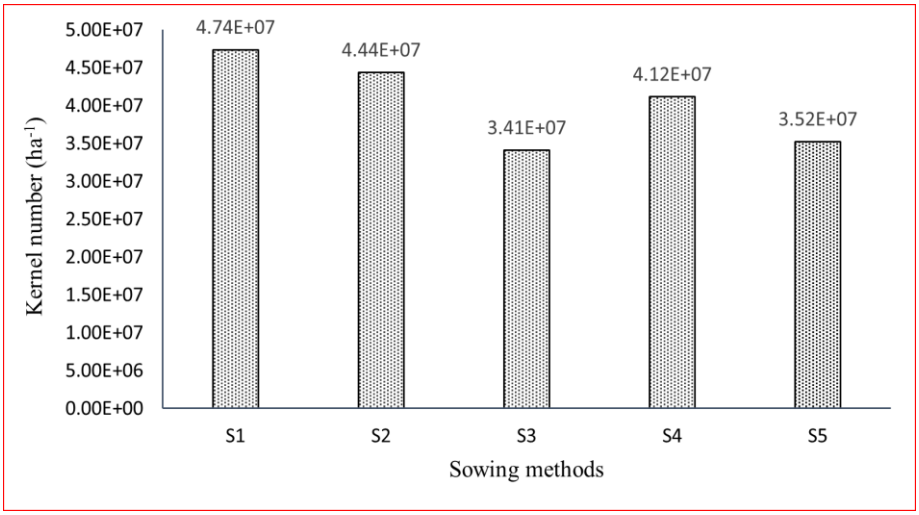

Figure. 5: Number of kernels number in different sowing methods

CONCLUSION

From the study it was concluded that sowing methods and row spacing does not affect the yield parameters. However, maximum kernel could be produced by using the flat method of sowing keeping 0.60 m row spacing.

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