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Sowing Dates and Sowing Methods Influenced on Growth Yiled and Yield Components of Pearl Millet under Rainfied Conditions

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Abstract
The objective of this study was to determine the effects of sowing dates and sowing methods on yield and yield components of pearl millet (*Pennisetum glaucum* L.). Therefore the field experiment was carried out at New Developmental Farm of The University of Agriculture, Peshawar, Pakistan during summer 2012. The experiment was laid out in randomize complete block design having five replications. The treatments consisted of three sowing dates (20th June, 10th July and 30th July) and two sowing methods (Direct seeding and transplanting seedling) were used. Sowing dates were significant for all parameters. Crop sown on 20th June had the maximum leaves plant^{-1} (93), plant height (230 cm), panicle length (26.3 cm), panicle weight (14.3 cm), grains panicle^{-1} (73.4), thousand grains weight (12.3 g) and grain yield (398 Kg ha^{-1}) as compared with other sowing dates but panicle weight and grains panicle^{-1} were statistically at par with 10th July sowing. Transplanted crop had significantly maximum leaves plant^{-1} (81), plant height (208 cm), grains panicle^{-1} (64), thousand grains weight (11.2 g) and grain yield (297 Kg ha^{-1}) as compared with direct sowing method. The interaction between sowing dates and sowing methods indicated that crop sown on 20th June through transplanted method had maximum panicle weight, grains panicle^{-1}, thousand grains weight and grain yield. It was concluded from this study that millet sown on 20th June with transplanted method seems to the best choice for millet producer under rainfied condition in Peshawar valley.
Keywords: Pennisetum glaucum, growth, yield, sowing methods, sowing dates

INTRODUCTION

Millet (*Pennisetum glaucum* L.), a member of the family Poaceae, is highly drought resistant summer crop grown under rainfied condition. Millet produces high quality grains than any other cereals under extreme conditions: like unfertile soil, intense heat and prolong drought. Besides Pakistan, millet is also commonly used as cereal crop for food in Africa, India and South Eastern Asia. Millet locally known as "Bajra" is an important grain and fodder summer season crop for both irrigated and rainfied areas of Pakistan (Khattak *et al.,* 2011). In Pakistan, millet was cultivated on an area of 548.4 thousand hectares with an annual production of 346 thousand tones and an average yield of 401 kg ha^{-1} in Pakistan whereas in Khyber Pakhtunkhwa its average yield was 420 kg ha^{-1} (MINFA, 2011). Planting time recommendations for pearl millet is commonly made based on calendar day or soil temperature (Andrews *et al*., 1998). Delay in sowing decreased values of all parameters (Iping 1997). Yield can be increased by the identification of higher yielding varieties and proper planting time (Khan *et al.* 2009 and Arif *et al.,* 2001). Timely planting of crops generally ensures sufficient time for root development and vegetative growth for optimum harvesting of available soil nutrients and radiant energy (Soler et al., 2007). Direct seeding offers such advantages as faster and easier planting, reduced labor, earlier crop maturity by 7–10 days, more efficient water use and higher tolerance of water deficit, less methane emission and often higher profit in areas with an assured water supply. The sowing date for direct seeding of millet plays vital role in improving its growth and increasing the yield. (Farrell et al., 2003). Transplanting cereal seedlings from nurseries has been adopted in several areas as a means of improving millet production by extending the growing season in areas with patchy and unreliable rainfall (Olabanji *et al.,* 1996). The use of transplants shortens the growth period in the field such that even late-maturing, high yielding cultivars can be made to fit into available growing season as dictated by either rainfall or temperature. Transplanting has proved successful in number of areas around the world (Olabanji *et al.,* 1996). Transplanting of millet varieties grown in nurseries has also been shown to improve establishment in the field (Maofumo, 2002). Time of sowing is an important factor that affect the growth cycle of the millet. Keeping in view the importance of sowing dates and sowing methods the present experiment was designed to find out the most suitable sowing date and sowing method for higher yield and yield components of pearl millet.

MATERIALS AND METHODS

Field experiment on sowing dates and sowing methods influenced on growth yield and yield components of pearl millet under rainfied conditions was conducted at New Developmental Farm The University of Agriculture, Peshawar (34^{o} 00' N, 71^{o} 30' E, 510 MASL) Pakistan during summer 2012. The experiment was carried out in randomized complete block design, having five replications. The treatments consisted of three sowing dates (20th

June, 10th July and 30th July) and two sowing methods (Direct seeding and transplanting seedling) were used. Plot size of 2 m x 5 m with 5 rows and 40 cm spacing. Nitrogen and phosphorus were applied as a basal dose at the rate of 50 and 30 kg ha^{-1} respectively at time of seedbed preparation. The crop was sown at seed rate of 20 kg ha^{-1}. The crop was sown either as direct seeding or transplanted. The seed for transplanting were sown in nursery on the same date as it was directly sown; therefore, the age of both type of seedlings were the same. The nursery seedlings were transplanted to field after two weeks. Number of leaves $plant^{-1}$ was counted in ten plants selected randomly in each subplot and then it was average. Data were recorded by measuring plants form ground level to the top of the five randomly selected plants in each subplot through measuring tape. After harvesting panicle length (cm) of ten randomly selected panicles were measured with measuring tape. Data on number of grains $panicle^{-1}$ were recorded by counting grain in ten panicles selected randomly in each sub plot and then its average was taken. After threshing data from thousand grains weight (g) were recorded for three seed lots and weighed with the help of electronic balance. Three central rows in each sub plot were harvested, sun dried and threshed. Seed weight was taken with an electronic balance and then converted into kg ha^{-1} by the following formula.

$$\text{Grain yield (kg ha}^{-1}\text{)} = \frac{\text{Grains weight in three rows (kg)}}{\text{No of rows x Row length x R-R}} \times 10{,}000\ m^2$$

All data collected were subjected to analysis of variance (ANOVA) with the help of statistical software, Statistix 8.0 USA (2005). Upon significant F-Test, least significance difference (LSD) test was used for mean comparison to identify the significant components of the treatment means.

RESULTS AND DISCUSSION

Number of leaves plant^{-1}

Data presented in Table 1 indicated that sowing dates and sowing methods had significant effect on number of leaves $plant^{-1}$ while the interaction between D x M had no significant effect on leaves $plant^{-1}$. Mean values of data indicated that crop sown on 20th June produced maximum (93) number of leaves $plant^{-1}$ while minimum (41) number of leaves $plant^{-1}$ was observed when crop was sown on 30th July. The reason could be that early sowing crop which has prolonged photoperiod as a result of more assimilates was utilized by plant in producing more leaves $plant^{-1}$ as compared to late sown crop. These results are in conformity with the findings of (Andrews *et al*., 1998). Millet sown through transplanting method produced significantly higher (62) number of leaves $plant^{-1}$as compared with direct seed sowing. These results are also conformity with the findings of (Maofumo, 2002).

Plant height (cm)

Statistical analysis of the data indicated in table 1 that sowing dates and sowing methods had significant effect on plant height while the interaction between D x M had no significant effect on plant height. Mean values of data showed that crop planted on 20th June attained significantly maximum height (230 cm) while minimum height (169 cm) was recorded for crop sown on 30th July. The possible reason could be that early sown crop had availed prolonged photoperiod for vegetative growth as a result plant attained maximum plant height as compared to late sown crop. These results are in line with those of Maas et al., (2007) who reported that crop which was sown at 15th June produced significantly taller plants while sown on 15th July produced dwarf plant. Millet grown through transplanting method attained taller plant height (208 cm) but dwarf (176 cm) plant height was recorded when millet grown through direct sowing . Plant height increased linearly with increased day length until June 17 and decreased significantly after this date Craufurd *et al.* (1988) stated that the duration of the vegetative phase in millet, which is the major cause of variation in the crop duration, has marked effects on main shoot. Transplanted millet resulted in taller plants than direct sowing millet.

Panicle length (cm)

Analysis of the data revealed in table 1 that sowing dates had significantly affected panicle length whereas sowing methods and the interaction between D x M were not significant effect on panicle length. Mean values of sowing dates revealed that crop sown on 20th June produced maximum panicle length (26.3 cm) while minimum (20.2 cm) panicle length was obtained when crop sown on 30th July. It might be due to early sown crop had avail prolonged photoperiod for vegetative growth as a result plant attained maximum panicle length as compared to late sown crop. These results are agrees with those reported by Teara *et al*. (1993) who reported that crop sown on 10th June produced maximum (29.5 cm) panicle length while late sown crop panicle length reduced up to (33%).

Panicle weight (g)

Sowing dates had significantly affected panicle weight, whereas sowing methods and the interaction between D x M were not significant effect on panicle weight. Plots sown on 20th June had significantly higher panicle weight (14.7 g) while lowest panicle weight (11.1 g) was recorded for 30th July sowing. These results are in line with those Leila *et al.* (2008) reported that delaying planting from 15th June significantly decreased panicle

weight in millet. A decrease in panicle weight for late planting dates can be attributed to changes in the duration of light interception (Craufurd *et al.* 1988). The interaction between D x M indicated in fig. 1 that both sowing methods panicle weight decrease with delay in sowing dates. But a linear increase was recorded for panicle weight when millet was sown on 20th June through transplanting method.

Number of grains panicle^{-1}

Number of grains panicle^{-1} was significantly affected by sowing dates and sowing methods. Mean value of sowing dates indicated that crop sown on 20th June produced maximum (73.4) number of grains panicle^{-1} but statistically at par with 10th July sowing while minimum (39.4) number of grains panicle^{-1} were recorded when crop sown on 30th July. The reason could be that early sowing crop which has prolonged photoperiod as a result more assimilates was going toward panicle and produced maximum number of grains panicle^{-1}. Similar results were reported by Craufurd *et al.* (1988) who recorded higher (71) number of grains panicle^{-1} in early sowing as compared to late sowing. Millet grown through transplanting method produced significantly higher (64.4) number of grains panicle^{-1} while minimum (59.5) number of grains panicle^{-1} was recorded in direct sowing method. Similar results were reported by (Olabanji *et al.,* 1996) who studied that maximum (68) grains panicle^{-1} were recorded when used transplanted method as compared with direct sowing method. The interaction between D x M indicated in fig. 2 that both sowing methods number of grains panicle^{-1} decrease with delay in sowing dates. But a maximum increase was recorded for number of grains panicle^{-1} when millet was sown on 20th June through transplanting method.

Thousand grains weight (g)

Mean values of sowing dates indicated in table 1 that crop sown on 20th June produced heavier (12.3 g) grain weight while minimum (9.8 g) grain weight was obtained when crop sown on 30th July. Earlier sown crop gained prolonged growth period with ideal growth condition as result heavier grains were produced as compared to late sown. Similar notations were reported by Teare *et al.* (1993) who reported that early sowing 10th June significantly improved seed weight as compared to late sowing 20th July. Millet grown through transplanting method produced significantly maximum (11.2 g) grain weight while minimum (9.8 g) grain weight was recorded in direct sowing method. Pal (1976) who studied that maximum 1000 grains weight was recorded through transplanted method as compared to direct sowing method (35%) reduction in 1000 grains weight was recorded. The superiority of transplanted millet over the directly sown crop might be due to the stresses in the environment are more likely to occur, the transplanted material, to withstand hazards better as compared to direct sowing method. The interaction between D x M indicated in fig. 3 that delayed in sowing dates from June to July, their was significant reduction in 1000 grains weight for both sowing methods. But a maximum increase was recorded for 1000 grains weight when millet was sown on 20th June through transplanting method.

Grain yield (kg ha^{-1})

Data regarding grain yield are presented in table 1. Mean value of sowing dates indicated that grain yield significantly reduced with delay in sowing. Plots sown on 20th June had significantly maximum grain yield (398 kg ha^{-1}) while minimum grain yield (195 kg ha^{-1}) was recorded when crop sown on 30th July. Early sowing had longer growth period as a result more grain yield was produced as compared to late sown these finding are in line with those of Soler *et al.* (2007). Millet grown through transplanting method produced significantly maximum (297 kg ha^{-1}) grain yield while minimum (250 kg ha^{-1}) grain yield was recorded in direct sowing method. These results are also conformity with the findings of (Maofumo, 2002) who reported that millet grown through transplanted method produced higher grain yield as compared to direct sowing method. It might be due to patchy and unreliable rainfall which decrease grain yield of millet grown through direct sowing method. The interaction between D x M indicated in fig. 4 that delayed in sowing dates from June to July, their was significant reduction in grain yield for both sowing methods. But a maximum increase was recorded for grain yield when millet was sown on 20th June through transplanting method.

Table I. Leaves plant^{-1}, plant height (cm), panicle length (cm), panicle weight (g), grains panicle^{-1}, thousand grains weight (g) and grain yield (kg ha^{-1}) of pearl millet as affected by sowing dates and sowing methods

Treatment	leaves plant^{-1}	Plant height (cm)	Panicle length (cm)	Panicle weight (g)	Grains panicle^{-1}	1000 grains weight (g)	Grain yield (kg ha^{-1})
Sowing Dates							
20th June	93 a	229.5 a	26.3 a	14.7 a	73.4 a	12.3 a	398 a
10th July	80 b	208.7 b	25.3 b	13.8 a	71.7 a	10.9 b	325 b
30th July	41 c	169.4 c	20.2 c	11.1 b	39.4 b	9.8 c	195 c
LSD (0.05)	7	12.5	0.9	0.9	3.1	1.0	39.2
Sowing Methods							
Direct Sowing	62 b	196.9 b	24.1	13.1	59.5 b	9.8 b	250 b
Transplanting	81 a	208.2 a	23.8	13	64.4 a	11.2 a	297 a
LSD (0.05)	5	10.2	ns	Ns	2.6	0.98	35.4
Interaction							
D x M	ns	ns	ns	*	*	*	*

Means in the same category followed by different letters are significantly different at P ≤0.05 levels. ns = non-significant * = significant

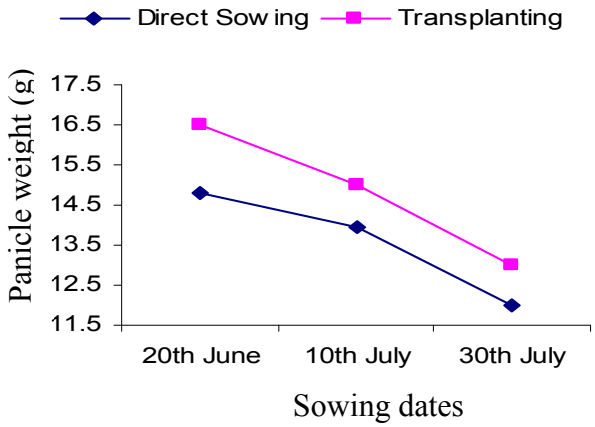

Fig. 1. Panicle weight of millet is affected by sowing dates and sowing methods.

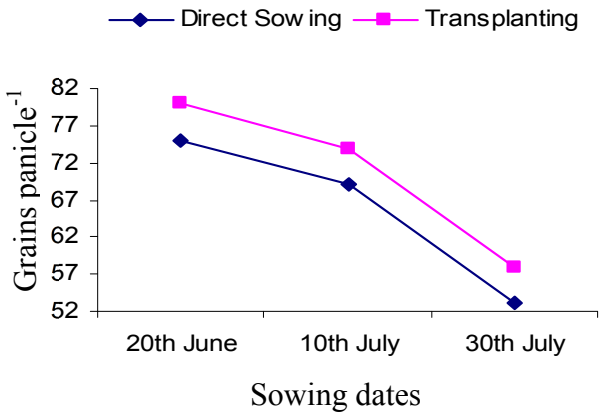

Fig. 2. Grain panicle^{-1} of millet is affected by sowing dates and sowing methods.

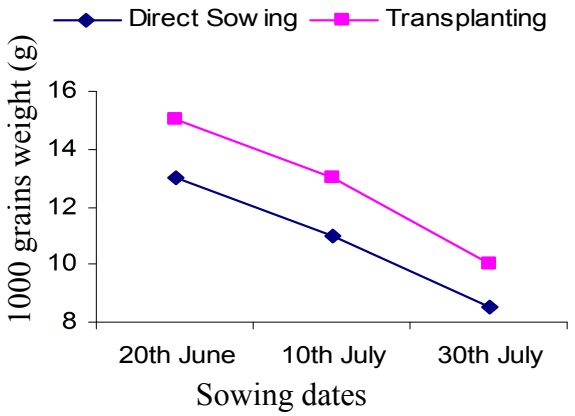

Fig. 3. 1000 grains weight of millet is affected by sowing dates and sowing methods.

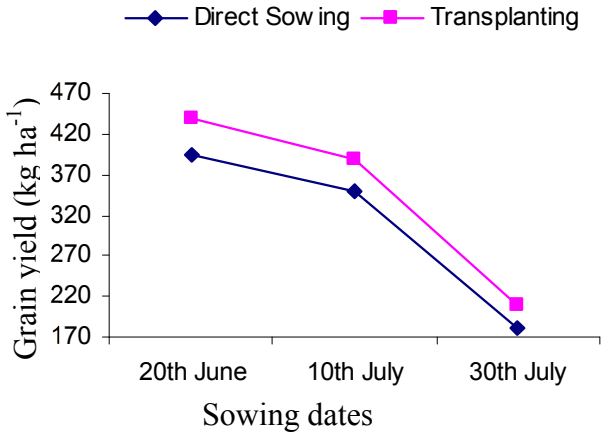

Fig. 4. Grain yield of millet is affected by sowing dates and sowing methods.

CONCLUSION AND RECOMMENDATIONS

From present research it can be concluded that millet sown on 20th June through transplanting method produced maximum panicle length, panicle weight, grains panicle^{-1}, 1000 grains weight and grain yield significantly and

therefore, it is recommended that pearl millet should be sown on 20th June under rainfied condition in Peshawar valley through transplanting method for higher yield and yield components.

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