ZIBELINE INTERNATIONAL PUBLISHING

ISSN: 2521-0858 (Print)
ISSN: 2521-0866 (Online)
CODEN: SHJCAS

Science Heritage Journal (GWS)

DOI: http://doi.org/10.26480/gws.01.2020.43.45

RESEARCH ARTICLE

MAIZE (ZEA MAYS) PRODUCTION UNDER DIFFERENT IRRIGATION TREATMENTS: INVESTIGATING THE GERMINATION AND EARLY GROWTH

Rana Shahzad Noor[a,b,*], Fiaz Hussain[b], Abu Saad[b], Muhammad Umair[b]

[a] Department of Agriculture, Biological, Environment and Energy Engineering, College of Engineering, Northeast Agricultural University, Harbin 150030, China.
[b] Faculty of Agricultural Engineering & Technology, PMAS-Arid Agriculture University, Rawalpindi 46300, Pakistan.
** Corresponding Author Email:* **engr.rsnoor@uaar.edu.pk**

ARTICLE DETAILS

Article History:

Received 10 August 2020
Accepted 12 September 2020
Available online 05 October 2020

ABSTRACT

Maize (Zea mays) is one of Pakistan's most important cereal crops and is widely used both for human consumption and for livestock feed. Seed germination, its morphological growth and yield depends on irrigation sequence. Rainfall is the only source of irrigation in Potohar region, Rawalpindi which mainly restrained sustainable agricultural practices. Therefore, a study was planned to investigate the effect of different irrigation frequencies (1-day, 3-days and 5-days interval) on germination and early growth of maize at Koont research station, PMAS-Arid Agriculture University, Rawalpindi during 2019 and 2020 crop seasons. The results elucidated that the continuous application of enough moisture via irrigation in 3-day interval enhance relatively higher (50%) percentage of germination followed by one day interval (43.75%). The enough moisture at five-day interval enhanced germination performance (68.75%). No significance effect was found on number of maize seedlings emergence while a considerable variation was observed on their emergence date, that the early emergence of maize seeds was enhanced in 1-day interval. As irrigation frequency decreased from 1 to 5 days interval, seedling emergence was delayed significantly ($p<0.05$). This indicated that a continuous application of enough water to the soil and maintaining soil moisture enhance the emergence of maize seeds to be takes placed earlier.

KEYWORDS

Maize (Zea mays), Irrigation frequency, Germination, Early growth.

1. INTRODUCTION

Irrigation artificial application of water to the soil for agricultural production purposes. It's generally considered when there are alleged rained crop production issues. Timing sum and length of rainfall can be inaccurate. For example, rainfall may vary from year to year, or rain starts and stops may be uncertain meanwhile, the rainy season itself may be a time of drought (Noor et al., 2019a). Irrigation systems are considered because they address the food production problem, and the materials that are needed or used for the procedure are not as scarce as they seem. Effective irrigation will impact the current growth and yield operation from seedbed preparation, germination, root growth, nutrient utilization, plant growth/regrowth, yield and quality (Noor et al., 2019b). Water is vital for irrigation purposes, but its extra judicial use can lead not only to scarcity but also to crop yields and soil degradation. Hence ensuring that it is implemented as efficiently as possible to achieve sustainability. Maize production increased with a combination of deep tillage and a good system of irrigation.

Maize (Zea mays) is one of the most important food crops grown primarily in Pakistan during the rainy season, widely used both for human consumption and livestock feed. Local crop yields are not enough to meet the steady increase in consumption (Noor et al., 2020a). So, a group researcher compared three irrigation methods in climatic conditions such as sprinkler, drip and furrow irrigation, it came to the conclusion that sprinkler is preferable to drip and furrow irrigation methods (Deborah et al., 2003). Sprinkler and drip irrigation are preferred to furrow irrigation, when contrasting the same irrigation methods in slope condition (Edakr, 2002). Whether sprinkler, drip or furrow, when a system is properly built, a significant effect was achieved on a crop's growth and yield (Franken et al., 2006).

Irrigation frequency is the number of days without rainfall between the irrigation intervals. Requirement for crop irrigation is the portion of crop water consumption, which must be supplied by irrigation to ensure optimum crop growth and development. With the human population and the resulting rise in regular demand for maize for different uses, it becomes imperative to intensify efforts in the country over the whole year. Traditional crop of maize is greatly affected by various weather conditions. The rain in the country is very uncertain and may either cause prolonged drought or water-logged conditions. It is, therefore, essential to consider both aspects of water requirement to produce 1 kg of dry mass that is the lowest in case of maize.

Quick Response Code	Access this article online	
	Website: www.jscienceheritage.com	DOI: 10.26480/gws.01.2020.43.45

Cite the Article: Rana Shahzad Noor, Fiaz Hussain, Abu Saad, Muhammad Umair (2020). Maize (Zea Mays) Production Under Different Irrigation Treatments: Investigating The Germination And Early Growth. *Science Heritage Journal, 4(1): 43-45.*

Thus, higher water use efficiency can be achieved by maize as compared to other cereal crops. Although maize needs less water requirement for germination, it needs 10 to 30 times greater than that of wheat and mustard. According to a study, it is very critical to have enough moisture for the maize seed, during germination so that successful seed germination may occur (Aslam et al., 2020). In Pakistan, there is no adequate information on early time water requirement of maize. In this study, the maize was sown in three intervals (One day interval, three-day interval and Five-day interval) at different irrigation frequencies to determine effect of the irrigation frequencies on germination and early growth of maize.

2. Material and Methods

2.1 Study Area

The field experiment was carried out for germination and early growth of maize (zea mays) under different irrigation sequence at Koont research station Chakwal, PMAS-Arid Agriculture University, Rawalpindi. Research area (semi-arid to sub humid) located between 33° 1' N to 33° 6' N and longitude 73° 30' to 73° 45' E. The bimodal rainfall occurs in late summer and winter season. Generally, about 60-70% rainfall received in monsoon season (June to September). However, winter rainfall occurs as gentle showers of longer duration, and thus, are more productive for agriculture (Noor et al., 2020b).

2.2 Experimental Treatments

Sterilized soil was filled in clay pots with a diameter of 8 cm and maize seed was sown. Four seeds were sown evenly and with the same sowing depth per pot. Pioneer-31 Y43 hybrid corn seed was used as the material for planting. The pots were arranged in greenhouse under CRD arrangement with four replications. At 1-day, 3-day intervals and 5-day intervals each set of 4 pots received irrigation with an equal volume of water for consecutive 20 days.

2.3 Experimental Data Collection and Analysis

The treatment was arranged in Completely Randomized Design (CRD) with four replications. Data collected consist of number seeds emerged, shoot length and biomass weight. The collected data was analyzed using SPSS-24 statistical analysis software and mean separation was made using Duncan's Multiple Range Test at significance level of 0.05. Seeds emergence was calculated after 5- & 7-days interval by counting normal seedlings till 20 days after sowing. At 20th day, the seedling biomass was gently washed to remove the soil and shoot length (cm) was measured from each treatment seedlings. To measure biomass weight (g), seedlings were dried in a forced air at green house at room temperature 28°C for 5 days.

3. Results and Discussion

The effects of irrigation frequencies on germination and early growths of maize seeds were observed under different irrigation frequencies. As shown in Table 1, irrigation frequencies had no significance effect on number of maize seedlings emergence, but considerable variation was observed on their emergence date, that the early emergence of maize seeds were enhanced during irrigation made daily than the rest of the treatments. As irrigation frequency decreased from 1 to 5-days interval, seedling emergence was delayed significantly (P<.0.05). This indicates that a continuous application of enough water to the soil and maintaining soil moisture enhance the emergence of maize seeds to be takes placed earlier. These findings are in agreement with the results, they stated that irrigation frequencies had a significant and negative effect on maize shoot length, as the date of irrigation elongated, the shoot length consistently and significantly reduced (Table 2) (Kang et al., 2001; Ismail et al., 2007). Thus, unlike maize seedlings emergence its growth very much dependent up on the amount and rate of irrigation. Similarly, irrigation frequencies had significance effect on maize biomass production. In that daily watered plots considerably outperformed the others in biomass weight gained.

A total of 16 seeds were used for each interval (One day interval, three-day interval and Five-day interval) and two counts were done during the present studies. The first count was done five days after sowing. In these rounds a total of 16 seed were used for each of the three intervals. The result elucidates that continuous application of enough moisture via irrigation in three-day interval enhance relatively higher (50%)of germination followed by one day interval (43.75%) (Figure 1). This inferred that moisture pressure negatively affects root initiations earlier even in pot growing conditions as in field conditions. This is related with a work done (Balesdent et al., 2000). The 14- or 21-day irrigation cycles prompted faster growth of seminal roots in seedlings compared with more regular irrigation. The delay in root development with regular irrigations may be due to the distribution of water into the seed for its early growth physiological processes. But, maintaining adequate amount of moisture in the soil fasten early emergence. A total of 16 seeds were used for each interval (1-day, 3-days and 5-days interval). The second count was done seven days after sowing. In these rounds a total of 16 seed were used for each of the three intervals. The result showed that the application of water or providing enough moisture at five-day interval enhance or promote relatively better germination performance (68.75%) followed one day interval (56.25%) (Figure 1). Table 2 indicated that the irrigation frequencies on all the treatments had no significance effect on number of maize seedlings emergence.

Table 1: Effect of irrigation frequencies on maize seeds Germination after 5 and 7 days of sowing

Treatments	seed sown	5 days after sowing						7 days after sowing					
		Pot 1	Pot 2	Pot 3	Pot 4	Seed germinated	% germination	Pot 1	Pot 2	Pot 3	Pot 4	Seed germinated	% germination
1-day interval	16	2	2	1	2	7	43 %	2	2	3	2	9	56.25%
3-days interval	16	2	1	2	3	8	50 %	2	3	2	1	8	50%
5-days interval	16	2	1	1	1	5	31.25%	2	3	3	3	11	68.75%

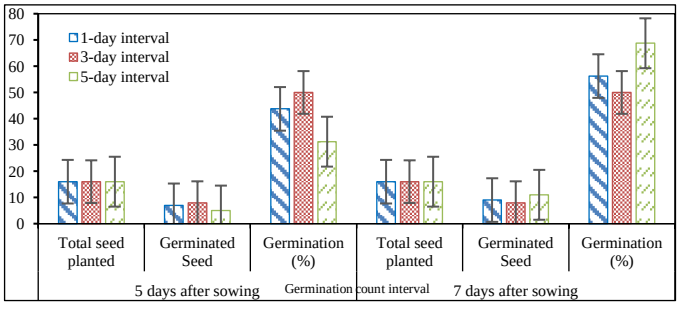

Figure 1: Evaluation of maize seed germination under three irrigation intervals after 5 & 7 days of sowing

Table 2: Effect of irrigation frequencies on different maize production characteristics

Treatment	Seedling emergence	Shoot length (cm)	Green biomass (g)	dry biomass (g)
1-day interval	4^{a}	52.88^{a}	83.00^{a}	9.13^{a}
3-days interval	4^{a}	41.95^{b}	48.03^{b}	4.92^{b}
5-days interval	4^{a}	41.10^{b}	36.65^{b}	4.30^{b}
CV (%)	0	13.42	15.419	13.3014
LSD (0.05)	0	10.52	14.911	1.4077
F Value	0	2.93	13.82	18.13
P Value	0	0.1114	0.0031	0.0015

Means with same letters within Columns aren't significantly different at P<0.05

Irrigation frequencies had significance effect on maize shoot length, therefore, as date of irrigation elongated the shoot length consistently and significantly reduced (Table 2). Thus, Treatment One day interval is significantly different from three days interval and five days interval. however, there is no significant difference between both treatment (Three-day interval and Five-day interval). Plants are more susceptible to water stress in the early stages of vegetative growth than those in the middle stages. Thus, water stress can result in reduced plant growth during the vegetative stages of crop growth (Cominelli et al., 2008). Plant height increases with increased water application. These results are confirmed by Dunford and Vazquez, where plants receiving more water accumulated more plant material and thus increased in height (Dunford and Vazquez, 2005).

Irrigation frequencies had significance effect on maize green biomass production among the treatments, for instance, in one day interval watered plots had maximum weight of green biomass when compared with the remaining treatments. However, there is no considerable significant difference between the two treatments (Three-day interval and five-day interval) in terms of green biomass. Irrigation frequencies had significance effect on maize dry biomass production among the treatments, for instance, in one day interval watered pots had maximum weight of dry biomass when compared with the remaining treatments. However, there is no considerable significant difference between the two treatments (Three-day interval and five-day interval) in terms of dry biomass.

4. Conclusion

The research work determined the effects of irrigation frequency on emergence and early growths of maize seedlings. The early growths of maize are greatly affected by the different irrigation frequency. So that, the different irrigation frequencies considerably affected plant shoot length, green biomass weight and dry biomass weight, however, results have revealed there is no significant difference among the treatments in terms of maize seed emergence. So that we concluded that moisture however is critical for seedling emergence in the treatments used in the study.

Acknowledgement

The authors acknowledge the PMAS-Arid Agriculture University Rawalpindi, Pakistan for providing the research facilities. The authors are thankful and acknowledged the Northeast Agricultural University, Harbin, China for their technical scientific support.

Conflict of Interest

The authors showed no conflict of Interest at any point for this manuscript

Source of Funding

This research received no external funding.

Author Contributions

Rana Shahzad Noor contributed in Conceptualization of research study, Design & Development of the experiment, Data collection, Formal Analysis, Investigation, Methodology, Visualization, writing an original draft, reviewed, supervised and Write-up editing. Abu Saad and Muhammad Umair contributed in Data collection, Formal Analysis, Investigation, Methodology, Visualization and Writing an original draft. Muhammad Umar Farooq and Abu Saad contributed in Data collection and data formal analysis.

References

Aslam, W., Noor, R.S., Hussain, F., Ameen, M., Saif, U., Chen, H., 2020. Evaluating Morphological Growth, Yield, and Postharvest Fruit Quality of Cucumber (Cucumis Sativus L.) Grafted on Cucurbitaceous Rootstocks. Agriculture, 10 (4), Pp. 101.

Balesdent, J., Chenu, C., Balabane, M., 2000. Relationship of soil organic matter dynamics to physical protection and tillage. Soil and tillage research, 53 (3-4), Pp. 215-230.

Cominelli, E., Galbiati, M., Tonelli, C., 2008. Integration of water stress response: Cell expansion and cuticledeposition in Arabidopsis thaliana. Plant Signaling and Behavior, 3, Pp. 556-557.

Deborah, J.N., Patricia, A., Matthew, H., 2003. Irrigation private proper wetlands in the Murray Valley, New South Wales. Ecological Management and Restoration, 4 (1), Pp. 5-12.

Dunford, N.T., Vazquez, R.S., 2005. Effect of water stress on plant growth and thymol and carvacrol concentrations in Mexican oregano grown under controlled conditions. Journal of Applied Horticulture, 7, Pp. 20-22.

Edakr, E., 2002. Determination of Irrigation Efficiency and Deep Drainage for Irrigated Maize with a Shadow Water Table. Proceeding of Symposium on soil water management November, USA.

Franken, S., Sieber, J., Hoogeveen, S., 2006. Irrigation Techniques, the Digital Global map of irrigation Area Development and validation of map version, 4.

Ismail, S.M., Ozawa, K., Khondaker, A.N. 2007. Effect of irrigation frequency and timing on tomato yield, soil water dynamics and water use efficiency under drip irrigation. Eleventh International Water Technology Conference, IWTC11 2007 Sharm El-Sheikh, Egypt. Pp. 69-84.

Kang, S., Zhang, L., Hu, X., Li, Z., Jerie, P., 2001. An improved water use efficiency for hot pepper grown under controlled alternate drip irrigation on partial roots. Sci. Hortic., 89, Pp. 257-267.

Noor, R.S., Hussain, F., Umair, M., Aslam, W., Ameen, M., Islam, M.A., Sheraz, M., 2020b. Yield and Economic Analysis of Peanut Production Under Different Soil Tillage Systems in North-East Region. Pakistan Journal of Agricultural Research, 33 (3), Pp. 490-497.

Noor, R.S., Hussain, F., Umair, M., Farooq, M.U., Saad, A., and Sun, Y., 2020a. Silage Corn Production Under Different Planting Methods in Rainfed Agriculture System: An Energy Analysis. Big Data In Agriculture (BDA), 2 (1), Pp. 32-35.

Noor, R.S., Wang, Z., Umair, M., Ameen, M., Imran, M., Sun, Y., 2019a. Performance Evaluation of a Water Seed Drill. Sustainability, 11, Pp. 137.

Noor, R.S., Wang, Z., Umair, M., Yaseen, M., Ameen, M., Rehman, S.U., Khan, M.U., Imran, M., Ahmed, W., Sun, Y., 2019b. Interactive Effects of Grafting Techniques and Scion-Rootstocks Combinations on Vegetative Growth, Yield and Quality of Cucumber (Cucumis sativus L.). Agronomy, 9, Pp. 288.