ISSN No:-2456-2165

Rain Water use Efficiency in Potato under Different Planting Dates and Mulching Treatments under Jorhat Condition, Assam

M. Panging, P.Neog[1], R.L Deka, Jogesh Goswami[2], Punya Khanikar, Kushal Sarmah And Pranjit Sutradhar[2]
Department of Agrometeorology, Assam Agricultural University,Jorhat-785013
[1]Department of Agrometeorology,B.N College of Agriculture,Biswanath-784176
[2]Department of Agronomy ,Assam Agricultural University ,Jorhat-785013

Abstract:- This study was conducted to determine the effect of RWUE under different dates of planting and mulching treatment during *rabi*, 2017-18 in the Instructional-Cum-Research (ICR) Farm of Assam Agricultural University, Jorhat. The variety – *Kufri Jyoti* was grown in split plot design with 3 dates of planting (P_1- 10th Nov, P_2- 20th Nov and P_3- 30th Nov) in main plots and mulches (M_0- non mulch, M_1- water hyacinth and M_2- black polythene) in sub-plots, following recommended agronomic practices. Microclimatic parameters like daily soil temperature (5 cm and 10 cm depth) and soil moisture content at 10 days interval from two depths (0 - 15cm and 15 - 30 cm) were recorded throughout the period of experiment. A total of 98.1 mm rainfall was received during the growing period and weekly average BSSH ranged from 1.3 to 9.2 hr. Irrespective of mulching treatments, the highest tuber yield of 112.8 q/ha was recorded in first date of planting (P_1), which was reduced by 11.68 and 14.22 per cent in second (P_2) and third (P_3) planting dates, respectively. The obtained result indicated that highest tuber yield of 120.8 q/hawasrecordedunder water hyacinth, followed by black polythene (103.5 q/ha) and non-mulched treatment (85.0 q/ha). Increased in tuber yield under water hyacinth was 42.12 per cent, while it was only 21.6 per centunder black polythene as compared to non-mulched condition. In potato cultivar *Kufri Jyoti*, irrespective of planting dates and mulching treatments the rain water use efficiency (q/ha/mm) varied from 2.72 to6.85 q/ha/mm with the overall mean of 4.60 q/ha/mm. Irrespective of mulching treatments, the highest RWUE was recorded in first date of planting (P_1) and lowest was recorded under second date of planting (P_2) of 4.81 q/ha/mm.

I. INTRODUCTION

Potato production isvery important industry throughout the world.In our country, more than 85 per cent of the potato grown area is confined to Indo-Gangetic plains and this region contributes more than 80 per cent to the total potato production (Pandey and Kang, 2003). In North East India the crop is grown as both *kharif* and *rabi* crop and the region occupies about 10 per cent of potato acreage and contributes 4 per cent of the total production in India (Gupta *et al*.,2004).

Potato is very sensitive climate variability and like many crops, potatoes are likely to be affected by changes in atmospheric carbon dioxide, temperature and precipitation, as well as affecting interaction between these factors. The crop is very sensitive to water stress because of its shallow root system; approximately 85 per cent of the root length iscon centrated in the upper 30.4cm of the soil (Iwama,2008) and 70 per cent of total water need is met by the crop from the upper 30 cm layer (Singh, 1968).Potato plants require a high degree of soil aeration; however, temporary dryness may reduce tuber yield. In the absence of sufficient rainfall, there is always low agricultural production, thereby creating food shortage and food insecurity. Hordofa *et.al*.(2008). In this regard moisture conservation with mulching is substantial. Since water is increasingly becoming an expensive and limited resource, it is necessary to improve crop water use efficiency to save water for greater yield. Gan *et al*. (2009) studied that low water availability and unpredictable precipitation in arid and semi-arid areas are the major problems which limiting the agricultural productivity. This issue has become more serious as global climate change has significant impacts on agricultural systems (Chmielewski *et al*., 2004). Turner and Meyer (2011) and Siddique *et al*. (2012) reported that in dryland environment the agriculture sustainability during the cropping season are threatened with the insufficient use of water, coupled drought and heat stress. To tackle the problem, new technologies have been developed to drastically increase the Precipitation Use Efficiency (PUE) in rain-fed farming systems reliant on precipitation. Thus, enhancing the use of rain water and improving field management to increase potato yield are necessary. The need for modernization and improvement of cultivation technologies is always present and mulching is one such technique which improves the ecological environment of the soil, growth and yield of vegetable crops. Mulch is used to cover soil surface around the plants to create congenial condition for the growth. This may include temperature moderation, reduce salinity and weed control (Patil *et al*., 2013). Plastic film can retain soil water content, allow full utilization of limited rainfall (Zhou *et al*.,2009).The organic mulches have attained greater value than the inorganic mulches in agricultural lands, as the organic mulches could increase the percolation and water retention of soil. Organic and inorganic mulches can better conserve the soil water as compared to synthetic (Arthur and Wang 1999) and barren (Lakatos *et al*.,2000) soil. Some organic mulch act as

ISSN No:-2456-2165

sponge and retain rainfall and irrigation water thus protecting the runoff and provides water at the time of crop requirement. Highly effective collection and utilization of rainfall is crucial to increase agricultural productivity where the crop yield generally depends on rainfall.The purpose of this research is to determine the role of mulching on soil moisture conservation, Rain Water Use Efficiency and yield of potato.

II. MATERIALS AND METHOD

A field experiment was conducted during *rabi*, 2017-18 in the Instructional-Cum-Research (ICR) Farm of Assam Agricultural University, Jorhat to study the Rain Water Use Efficiency of Potato Crop under different date of planting and mulching treatment. The variety – *Kufri Jyoti* was grown in split plot design with 3 dates of planting (P_1- 10th Nov, P_2- 20th Nov and P_3- 30th Nov) in main plots and mulches (M_0- non mulch, M_1- water hyacinth and M_2- black polythene) in sub-plots, following recommended agronomic practices.

The rain water use efficiency (RWUE) *i.e.*tuber yield per unit of rainfall received during the crop growth period were computed for potato cultivar *Kufri Jyoti* grown in three dates of planting and mulching treatment during *rabi*,2017-18.Rainfall received one day before the date of physiological maturity in case of first and third date of planting were not considered for computing RWUE as the rainfall received in the previous day of the physiological maturity could not contribute to the tuber yield of the crop. During the crop season, a total rainfall of 91.1 mm was received in 6 rainy days. The maximum weekly total rainfall of 56.3 mm from 3 rainy days was recorded at 9th SMW which coincided with the harvesting stage of the crop planted on 30 November (P_3). Rainfall during the crop growing season was not evenly distributed and 83 per cent of total rainfall was recorded in the last seven SMW (4, 5, 6 7, 8 and 9th SMW) of the crop season.

III. RESULTS AND DISCUSSION

In potato cultivar *Kufri Jyoti*, irrespective of planting dates and mulching treatments the rain water use efficiency (q/ha/mm) varied from 2.72 to 6.85 q/ha/mm with the overall mean of 4.60 q/ha/mm. Irrespective of mulching treatments, the highest RWUE was recorded in the first date of planting (P_1), which ranged from 4.66 to 6.85 q/ha/mm with mean value of 5.70 q/ha/mm while the lowest RWUE of the tuber yield was recorded under second date of planting (P_2), which varied from 2.72 to 3.84 q/ha/mm with mean value of 3.30 q/ha/mm. However, in case of third date of planting (P_3), the RWUE varied from 4.01 to 5.51q/ha/mm with mean value of 4.81 q/ha/mm.

Dates of planting	Mulching treatments	Yield (qt/ha)	Rainfall (mm)	RWUE (qt/ha/mm)
P_1	M_0	92.27	19.80	4.66
	M_1	135.63	19.80	6.85
	M_2	110.56	19.80	5.58
	Mean	**112.82**	**19.80**	**5.70**
P_2	M_0	82.05	30.20	2.72
	M_1	116.10	30.20	3.84
	M_2	100.77	30.20	3.34
	Mean	**99.64**	**30.20**	**3.30**
P_3	M_0	80.68	20.1	4.01
	M_1	110.69	20.1	4.66
	M_2	98.97	20.1	6.85
	Mean	**96.78**	**20.1**	5.58

Table 1: Rain Water Use Efficiency in *Kufri Jyoti* under different planting dates and mulching treatments

Irrespective of planting dates, the highest and the lowest RWUE were recorded under water hyacinth and non-mulched treatment, respectively. The RWUE under water hyacinth (M_1) ranged from 3.84 to 6.85q/ha/mm with mean value of 5.40 q/ha/mm and under non-mulched condition it varied from 2.72 to 4.66 q/ha/mm with mean value of 3.80 q/ha/mm. However, in case of the crop grown under black polythene, the RWUE varied from 3.34 to 5.58 q/ha/mm with mean value of4.61 q/ha/mm.

The highest RWUE of tuber yield in first date of planting (P_1) could be attributed to higher tuber yield and less amount of rainfall received during the crop growth period as compared to second (P_2) and third (P_3) dates of planting. On the other hand, the lowest RWUE was recorded under second date of planting (P_2), which might be due to reduction of tuber yield in-spite of receiving highest amount of rainfall (30.2 mm) during the crop growth period.

Throughout the growing season, RWUE was highest under water hyacinth, which might be due to record of the higher tuber yield in all dates of planting as compared to other mulching treatments. Though black polythene mulch appreciably reduced the evaporation from the soil, it did not allow the rain water to penetrate into the soil. That is why, in case of black polythene mulching, the crop was not able get the advantages of rainfall occurred during the crop growing season, which was reflected in reduction of crop performance in terms of plant height, LAI, biomass production and tuber yield under decreased soil moisture retention and finally reduction of RWUE.

The results are in conformity with earlier findings of Mukherjee *et al.*,(2010),who reported that under non-mulched situation, uninterrupted solar radiation reached the soil surface increased evaporation and resulted in lower RWUE. Above results are also supported by findings of Neog *et al.*,(2018) who reported that application of organic mulch in potato resulted in higher tuber yield (20.63 t/ha), RWUE (2.52 q/ha) and B:C ratio (1.69), as it helps in better utilization of residual soil moisture by the crop.

ISSN No:-2456-2165

IV. CONCLUSION

It can be concluded that time of planting has a great influence on yield of potato crop and planting time before 15th Nov is optimum for obtaining better yield. It also reveals that different mulching exhibited significant impacts on yield of potato crop. Organic mulch such as water hyacinth conserves soil moisture, increase yield and rain water use efficiency to a great extent. Therefore, mulching strategy helps in increasing the Rain water use efficiency and will reduce the water requirement of potato crops under water deficit/drought conditions.

REFERENCES

[1.] Arthur MA,Wang Y (1999).Soil nutrients and microbial biomass following weed-control treatments in a christmas tree plantation.J.Ame.Soc.Soil.Sci.63:629-637.

[2.] Chmielewski F. M., T. Müller, and A. Bruns (2004). Climate changes and trends in phenology of fruit trees and field crops in Germany. Agricultural and Forest Meteorology, 121(1-2): 69–78.

[3.] Gan, Y.T., G. B. Huang, L. L. Li, J. H. Liu, and Y. G. Hu (2009). Unique conservation tillage practices in northwest China. World Association of Soil and Water Conservation, 60, pp.429–445.

[4.] Gupta, V.K., Thakur, K.C. Kumar, S., Pandey, S.K. and Sah, U. (2004). True Potato Seed- An alternative technology for potato production in North eastern hill region.Technical bulletin, no **64**, Central Potato Research Institute, Shimla, p. 1.

[5.] Iwama, K. (2008). Physiology of the potato: New insights into root system and repercussions for crop management. *Potato Res*. **51**: 333–353.

[6.] Laktos T,Buban T,Muller W,Polesny F,Verheyden C,Webster AD (2000).Effectiveness of different groundcover materials to preserve soil water content in a young aoole orchard.Acta.Hortic.525:425-426.

[7.] Neog, P., Sarma, P.K., Borah, P., Sarma, D., Sarma, M.K., Borah, R., Hazarika, G.N. and Chary, G.R. (2018). Climate Resilient Agriculture Expereinces from NICRA Implementation in North Bank Plains Zone of Assam. Research Bulletin (AAU/DR/18(BL)/229/2018-19). Biswanath College of Agriculture,AAU., Publised by All India Coordinated Research Project For Dryland Agriculture, BiswanathChariali (MC), Biswanath, Assam-784176.

[8.] Pandey, S.K. and Kang, G.S. (2003). Ecological Zones and Varietal Improvement In: Paul, S.M., Khurana, Minhas, J.S., Pandey, S.K. (Eds) The Potato: Production and Utilization in Sub Tropics. Mehta Publishers, New Delhi, pp. 48-60.

[9.] Patil, D.D., Pandey, V., Acharya, R.R. and Baraiya, L.N. (2018). Effect of intra-seasonal variation in temperature on tuber yield of potato in middle Gujarat using SUBSTOR model. *J. Agrometeorol*. **20**(1): 22-27.

[10.] Siddique, K. H. M., C. Johansen, N. C. Turner, M. -H. Marie-Hélène Jeuffroy, A. Hashem, D.G. Sakar, and S.S. Alghamdi. 2012. Innovations in agronomy for food legumes- A review. Agronomy for Sustainable Development, **32**(1): 45–64.

[11.] Singh, A.K. (1968). Water requirement of potatoes. Proc. Symp. Water Management, Udaipur, 169-172.

[12.] T. Hordofa, M. Michael, B. Sileshi, and E. Teklu.(2008) “Irrigation and rain-fed crop production system in Ethiopia,” in Impact of Irrigation on Poverty and Environment in Ethiopia, pp. 27–36, International Water Management Institute, Addis Ababa, Ethiopia.

[13.] Turner, N.C. 1997. Further progress in crop water relations. Advances in Agronomy, **58**(1): 293–338.

[14.] Zhou, L., F. Li, S. Jin, and Y. Song, (2009). How two ridges and the furrow mulched with plastic film affect soil water, soil temperature and yield of maize on the semiarid Loess Plateau of China. Field Crop Research, **113**(1): 41–47.