International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2017; 5(4): 479-482

Received: 05-05-2017
Accepted: 06-06-2017

VN Game
Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

SA Chavan
Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

HM Patil
Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

Correspondence
VN Game
Department of Agronomy, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Maharashtra, India

Irrigation studies of Rabi sweet corn (*Zea mays saccharata* L.) Influenced by irrigation methods and irrigation regimes grown under different mulches

VN Game, SA Chavan and HM Patil

Abstract
Water is prime for all biological activities and now days, water has been recognized more precious than gold and oil. Hence, field experiment was conducted to study the influence of irrigation methods, irrigation regimes and mulches on the performance of *rabi* sweet corn during *rabi* season of years 2014-15 and 2015-16 on coastal lateritic soils of konkan region. The experiment was laid out in split plot design with four main plot and five sub plot treatments. The main plot treatments comprised of four combinations of irrigation methods and irrigation levels *viz*., Drip irrigation with 100 % water requirement, Drip irrigation with 75 % water requirement, Check basin irrigation with 100 % water requirement and Check basin irrigation with 75 % water requirement. The five sub plot treatments consisted different types of mulches *viz*., No mulch *i.e*. control, Paddy straw mulch, Black polythene mulch, Transparent polythene mulch and Silver polythene mulch. Thus, there were twenty treatment combinations, replicated thrice. Results in the pooled mean data revealed that the maximum cob yield and net return can be achieved by the intervention of drip irrigation and black polythene mulch ($ID_{100}M_2$). The results showed that the maximum water use efficiency can be achieved with the application of one ha.cm water under treatment $ID_{75}M_2$ as well as ₹126.19 can be fetched with the investment of one m^3 of water in this treatment. Drip irrigation with 75 % water application without mulch ($ID_{75}M_0$) recorded higher water use efficiency and water productivity as compared to 100 % water application through drip without mulch ($ID_{100}M_0$). Application of 75 % irrigation water through drip along with the use of polythene mulches produced higher water productivity as compared to application of 100 % water through drip along with polythene mulches.

Keywords: Irrigation, Mulches, Sweet corn

Introduction
In India, maize (*Zea mays*) is emerging as a third most important crop after rice and wheat. Its importance lies in the fact that it is not only used for human food and animal feed but at the same time it is also widely used for corn starch industry, corn oil production, baby corns etc. Sweet corn (*Zea mays saccharata* L.) also known as sugar corn is hybridized version of maize specifically breed to increase the sugar content.

Sweet corn is gaining popularity both in rural and urban areas because of its high sugar and low starch content. It has great market potential and high market value in India. Cobs have good market potential. Also after harvesting of crop nutritious and palatable fodder can be available for milch animals. Water is prime for all biological activities and now days, water has been recognized more precious than gold and oil. Soil and water are being basic limited resources, it is necessary to have proper planning for its optimal use for maximizing the production of food and fibre to satisfy the demand of increased population. This can be achieved by additional development and efficient management of available water resources. Good quality water is having multifarious application such as for irrigation, industrial use, power generation, livestock use, and domestic use both in urban and rural areas. Generally, irrigation frequency and water application methods play an important role to achieve potential yield of food, fibre and vegetable crop. Therefore, it becomes essential to give more concern over scheduling of irrigation, which will helps to achieve higher productivity, optimum use of water with better irrigation efficiency. An ideal irrigation schedule must indicate time of irrigation water application and the quantity of water to be applied.

In recent years some useful techniques have been evolved to minimize water loss through evaporation such as use of different plastic mulches or any other organic material available on farm. Plastic mulches have been used commercially on vegetable crops since early 1960's in the United States. This showed significant improvement in earliness, higher yield and improvement in fruit quality when grown under plastic mulch (Kumar and Lal, 2012) [3]. Plastic mulches involves spreading polythene sheet over soil surface to conserve moisture, raised soil temperature in winter season and to minimize weed growth. Sweet corn can be a promising short duration cash crop and there is wide scope during rabi season for cultivation, as it fetches better market price if timely sowing and proper managerial practices are followed in Konkan region. Also, better water use efficiency during rabi season through water saving and by use of micro irrigation techniques in sweet corn is profitable for increasing the yield of the crop by 20 to 100 per cent as compared to conventional methods and in addition saving of labours. Considering the commercial demand of sweet corn in this region, its productivity needs to be increase. This is possible through management of micro climate, quantity of irrigation water and agronomic practices like mulching. Adoption of this might help in raising the irrigated area, productivity of crops and water use efficiency.

Materials and Methods

The experiment was laid out in plot no. 20 of 'B' block of Agronomy Farm, College of Agriculture, Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri during *rabi* season of years 2014-2015 and 2015-2016 to evaluate the, effect of irrigation methods, irrigation regimes and mulches on the performance of *rabi* sweet corn (*Zea mays saccharata* L.). Soil was medium in available nitrogen, low in available phosphorus and fairly high in available potassium. The field experiment was laid out in split plot design comprising of twenty treatment combinations replicated thrice. The main plot treatments comprised of four combinations of irrigation methods and irrigation levels *viz*., Drip irrigation with 100 % water requirement (ID_{100}), Drip irrigation with 75 % water requirement (ID_{75}), Check basin irrigation with 100 % water requirement (IC_{100}) and Check basin irrigation with 75 % water requirement (IC_{75}). The five sub plot treatments consisted different types of mulches *viz*., No mulch *i.e*. control (M_0), Paddy straw mulch (M_1), Black polythene mulch (M_2), Transparent polythene mulch (M_3) and Silver polythene mulch (M_4). The gross plot size of each treatment was 3.60 m X 3.00 m and net plot size was 2.40 m X 2.60 m, respectively. Drip irrigation system with 16 mm lateral was installed. The emitters were 60 cm apart and had a constant discharge rate of 4 LPH. The drip irrigation laterals were installed before spreading the mulch and the dripper were checked for the discharge. The plot area as per the treatment was covered with paddy straw mulch, black polythene mulch, transparent polythene mulch and silver polythene mulch before sowing. Polythene mulches used for mulching had 120 cm width, 25 micron thickness with 100 % elasticity. The border of polythene mulch was incorporated in the soil for trapping of heat and to avoid disturbance from wind. Round holes were made at the spacing of 60 x 20 cm with the help of GI pipe of 2 inch diameter. Paddy straw mulch of 5 cm thickness was spread over the respective plots. All recommended package of practices were followed during the experiment period. In order to ensure better germination and initial crop stand two common irrigations were given to all the treatments. Drip irrigation was scheduled on the basis of pan evaporation data on every alternate day. Under check basin, irrigations were given on the basis of cumulative pan evaporation at 70 mm CPE with 60 mm depth as per treatments. Water use efficiency is the ratio of marketable produce of the crop and seasonal water requirement of crop during it's period. The pan evaporation was measured daily from the USWB class 'A' open pan evaporimeter installed at the Agronomy Department Farm, College of Agriculture, Dapoli during the period of experiment. The irrigation requirement was estimated by considering crop coefficient as per the growth stage. For ascertaining the effect of different treatments on growth and development of the sweet corn crop, biometric observations were recorded timely.

Results and Discussion

The results of the cob yield as well as net returns as influenced by different treatment combinations in the pooled mean of both years are iterated in Table 1. These results were tabulated to evaluate comparative influence of treatment combinations in regard to the water saving and increase or decrease in yield as compared to the traditional way of water application i.e. 100 % irrigation through check basin method and without application of mulch ($IC_{100}M_0$). The results revealed that the maximum cob yield of 29.61 t ha^{-1} can be achieved by the intervention of drip irrigation and black polythene mulch ($ID_{100}M_2$) followed by 28.56 t ha^{-1} in $ID_{75}M_2$ treatment combination. The net returns of 234589 ha^{-1} can be fetched with $ID_{100}M_2$ treatment combination. The lowest yield of 14.20 t ha^{-1} was achieved with 75 % water application through check basin method without application of mulch in the pooled mean. The low yield in this treatment can be attributed to the more moisture stress to crop as well as loss of water due to evaporation because of no application of covering material.

Irrigation water utilization

The results pertaining to water saving, increase or decrease of yield over $IC_{100}M_0$ treatment and the water use efficiency and water productivity in the pooled mean are given in Table 1. The results indicated that water saving in the range of 52.3 to 62.9 % can be achieved due to the water application through drip irrigation to sweet corn. The yield of sweet corn to the tune of 90 % can be increased due to drip irrigation along with application of black polythene mulch (M_2). The increase in yield due to drip irrigation and application of mulches was varied in the range of 35 to 90 % over treatment combination $IC_{100}M_0$. In other words, about 50 to 60 % more land can be brought under irrigation with adoption of drip irrigation to cultivate sweet corn as compared to check basin method of irrigation. The second highest cob yield of sweet corn (28.56 t ha^{-1}) was achieved in treatment combination $ID_{75}M_2$ i.e. 75 % water application through drip irrigation along with black polythene mulch. The advantage of this treatment would be attributed as the water saving of 20.3 % can be achieved. However, the yield may be decreased by 3.5 % as compared to 100 % water application with same type of mulch ($ID_{100}M_2$). These results confirm that the treatment combination $ID_{75}M_2$ can be adopted in water scarce condition in which only 179 ha. mm irrigation water is needed with the saving of 51 ha-mm water to grow sweet corn.

The water saving under drip irrigation treatments was observed only due to the application of limited amount and frequent application of water. In case of traditional method, whole area is wetted at one time and the field is let for some

days without water application. This leads to loss of excess water due to percolation during the period of water application and as whole area is wetted, thus the area for evaporation is also increased. Therefore, water applied through this method leads to double loss of water that is due to deep percolation and evaporation.

Water use efficiency (kg ha.cm^{-1}) and water productivity (m^{-3})

The water use efficiency and water productivity are the indicators of how much crop can be produced by using a particular amount of irrigation water as well as how much monitory gain can be earned with the investment of particular amount of irrigation water. The results showed that the maximum water use efficiency of 1619.80 kg ha.cm^{-1} can be achieved with the application of one ha.cm water under treatment $ID_{75}M_2$ as well as 126.19 can be fetched with the investment of one m^3 of water in this treatment. The results indicated that water use efficiency in the range of 861.43 to 1619.80 kg ha.cm^{-1} and 325.90 to 611.05 kg ha.cm^{-1} can be achieved from sweet corn due to the water application through drip irrigation and check basin irrigation method respectively in the pooled mean. Also water productivity obtained in drip and check basin irrigation method range from 60.18 to 126.19 m^{-3} and 20.04 to 38.66 m^{-3}, respectively with the investment of one m^3 of water.

The results corroborated that more yield, water use efficiency and water productivity can be achieved with the application of mulches as compared to no mulch. Among different mulches used in the study, black polythene mulch recorded the highest water use efficiency as compared to other mulches and no mulch treatments. This mulch produced the highest yield as well as water use efficiency and water productivity irrespective of irrigation methods and irrigation regimes. Drip irrigation with 75 % water application without mulch ($ID_{75}M_0$) recorded higher water use efficiency and water productivity as compared to 100 % water application through drip without mulch ($ID_{100}M_0$). This indicated that 25.38 % more water use efficiency can be achieved with 25 % less water application by using drip irrigation without mulch. Also 15 % more monitory return can be fetched per water application of one m3 with 75 % water application through drip irrigation without mulch.

Results also indicate that the water productivity range from 60.18 to 126.19 m^{-3} and 20.36 to 40.74 m^{-3} can be achieved from sweet corn due to the water application through drip irrigation and check basin irrigation method respectively. Application of 75 % irrigation water through drip along with the use of polythene mulches produced higher water productivity as compared to application of 100 % water through drip along with polythene mulches. In other words, with application of 25 % less water through drip irrigation method and along with polythene mulches higher money can be fetched with the investment of one m3 of water in this treatment. In case of check basin irrigation method, the mulches could produce their influence in increasing the yield, water use efficiency and water productivity as compared to no mulch condition.

As per irrigation method is concerned, the sweet corn yield was increased due to water application through drip irrigation as compared to check basin method of irrigation. This is obvious because due to frequent and precise water application the moisture content in the root zone is maintained near to field capacity (Kumari *et al*., 2006) [4]. Thus the crop does not suffer due to moisture stress. In case of check basin method as the irrigation was scheduled after 17-20 days (70 mm evaporation) during crop period, the crop might be suffer due to excess moisture content during the days immediately after irrigation and further the crop might be under moisture stress prior to next irrigation (Patil, 2008) [5]. Such repeated moisture excess and stress condition faced by the crop might have resulted in reduced yield in check basin method of irrigation. However, the mulch condition might have produced the moisture stress upto certain extent. Thus, the yield in check basin method of irrigation under mulched condition was higher than no mulch condition.

The percent increase in the yield was higher under black polythene mulch which was followed by silver polythene mulch and transparent polythene mulch. This might be due to maintaining favorable soil temperature under black polythene mulch due to higher absorption of heat being complete black body. Black polythene mulch absorbs ultraviolet rays from the sun which transmits the absorbed radiation into the soil as thermal radiation due to which soil temperature remains higher. This increase in soil temperature was favorable during the period of minimum temperature which ranged from 9.6 to 190C during crop growth and development period. Also the weeds were completely controlled under black polythene mulch which prevents the loss of water through transpiration. Due to this reasons black polythene mulch was superior over rest of the mulches.

In case of silver polythene mulch, the reflectivity is higher as compared to black polythene mulch which results in lower soil temperature under silver polythene mulch. Transparent polythene mulch absorbs very little solar radiation and reflectivity is higher as compared to black and silver polythene mulches (Anonymous, 2011) [1]. Also the weeds were observed under transparent polythene mulch which resulted in lower yield as compared to black and silver polythene mulches. These results are in close conformity with those of Gosavi (2006) [2].

Table 1: Quantity of water applied, cob yield, net returns, per cent water saving over $IC_{100}M_0$, Per cent increase or decrease in yield, water use efficiency and water productivity of the sweet corn as influenced by the different treatment combinations mean data of year 2014-15 and 2015-16.

Treatments	Quantity of water applied (ha.cm)	Cob yield (t ha^{-1})	Net Returns (₹ ha^{-1})	Per cent increase/ decrease in yield over $IC_{100}M_0$	Water Use Efficiency (kg $ha.cm^{-1}$)	Water productivity (₹ m^{-3})
ID_{100} M_0	22.98	19.54	136967	25.40	861.43	60.18
ID_{100} M_1	22.98	22.24	156688	42.69	979.65	68.85
ID_{100} M_2	22.98	29.61	234589	89.99	1305.91	103.32
ID_{100} M_3	22.98	26.45	198509	69.70	1162.35	87.09
ID_{100} M_4	22.98	27.12	205380	74.01	1195.16	90.20
ID_{75} M_0	17.87	19.08	122465	22.42	1080.11	69.18
ID_{75} M_1	17.87	21.05	143149	35.06	1191.06	80.82
ID_{75} M_2	17.87	28.56	222835	83.25	1619.80	126.19
ID_{75} M_3	17.87	24.73	177011	58.67	1400.39	99.99
ID_{75} M_4	17.87	26.70	200876	71.32	1519.10	114.24
IC_{100} M_0	48.00	15.58	97354	-	325.90	20.36
IC_{100} M_1	48.00	18.62	127208	19.47	388.10	26.44
IC_{100} M_2	48.00	25.72	194982	65.06	537.53	40.74
IC_{100} M_3	48.00	22.79	162755	46.23	476.37	33.99
IC_{100} M_4	48.00	23.89	177188	53.28	498.90	36.97
IC_{75} M_0	39.75	14.20	79263	-8.85	358.50	20.04
IC_{75} M_1	39.75	16.40	101534	5.26	413.84	25.57
IC_{75} M_2	39.75	24.21	154570	55.37	611.05	38.66
IC_{75} M_3	39.75	20.45	142388	31.21	515.41	36.45
IC_{75} M_4	39.75	21.36	145558	37.08	539.07	36.74

Conclusion

For obtaining higher yield and net returns sweet corn (variety-Sugar 75) should be grown under drip irrigation system with application of 100 % water requirement along with black polythene mulch. Water use efficiency and water productivity of sweet corn can be increased with application of water through drip irrigation method along with black polythene mulch. Under water scarcity condition sweet corn can be grown with drip irrigation with 75 % water requirement (17.9 ha.cm) along with black polythene mulch.

References

1. Anonymous. Practical manual on plastic mulching. Published by National Committee on Plasticulture Applications In Horticulture. 2011, 2-6.
2. Gosavi SP. Effect of mulches, fertilizer and levels of organic manure on the performance of *rabi* sweet corn (*Zea mays saccharata*). Thesis submitted for M.Sc. (Agri.) degree to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri (M.S), 2006.
3. Kumar SD, Lal BR. Effect of mulching on crop production under rainfed condition: A review. Intl. J. Res. Chem. Environ. 2012; 2(2):8-20
4. Kumari R, Prasadini PP, Rao MS, Shivshankar M. Effect of drip irrigation and mulches on growth and yield of bell pepper (*Capsicum fruitesens* L.). Ann. Agric. Res. 2006; 27(2):179-182
5. Patil SA. Effect of irrigation and fertigation levels on growth, yield and quality of sweet corn (*Zea mays saccharata*) in rabi season under medium black soils of north Konkan. Thesis submitted for M.Sc. (Agri.) degree to Dr. Balasaheb Sawant Konkan Krishi Vidyapeeth, Dapoli, Dist. Ratnagiri, (M.S), 2008.